Sovereign Debt Default and Bank Risk in China

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Abstract

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Following the 2008 global financial crisis, sovereign default risk has become an important issue in Europe, as many Eurozone countries such as Greek and Portugal fell into serious debt problems. The sovereign default problem in these countries not only negatively impacts the overall economy of the countries, but also slows down the recovery process or even endangers the financial system of the Eurozone as a whole.

Some researchers have studied the sovereign default problem in Eurozone countries. For example, Reinhart and Rogoff (2010) tested the relationship between government debt and bank crisis, and found a strong link between them. In addition, Gennaioli, Martin and Rossi (2014) claimed that public default weakens the balance sheets of banks which hold public bonds. Further Reinhart and Rogoff (2010) confirmed that the run-up in debts acceleration is an important signal of a bank crisis.

The debt issue is not confined to Eurozone countries. Based on JP Morgan reports, at the end of 2012, the total Chinese government debt (central and local government

debts) in terms of GDP ratio was 187%, reaching 282% in 2015. This high government debt level can potentially endanger the financial stability of China and its overall economy. In addition, it may result in a bank crisis in China. This study tests a potential sovereign debt problem and bank risk in China's financial market. This includes the origin of the sovereign debt problem (what factors contribute to sovereign default), the negative impact of sovereign debt issues (for example the impact on economic growth and the financial system) and the interaction of sovereign debt and bank sectors (that sovereign default can negatively impact the banking system. On the other hand, banking factors also impact the sovereign debt problem).

This study tested the sovereign debt dynamics of China. The results confirmed a sovereign debt problem in China since 2009, which could be the result of the massive government expenditure since 2008. Secondly, this study estimated the sovereign risk of China based on macroeconomic fundamentals. The results found significant impact of macroeconomic fundamentals (debt burden, government revenue, debt interest rate, economic growth and inflation) on the sovereign risk in China. This provides a potential mechanism for the Chinese government to make concerted decisions to control the sovereign debt risk. Finally, this study investigated the impact of sovereign risk on bank risk in China. The results showed strong link between sovereign risk and bank risk especially for government-owned banks in China, which warn banks and government of China to pay attention to the spillover effect between sovereign risk and bank risk.

Keywords: Sovereign debt, China, Financial system, Risk

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Chapter 1
Introduction

1.1 Introduction

Since the central bank of Iceland crashed in October 2008, the sovereign debt problem has become a serious problem in the global financial system. In fact, recent sovereign debt problems have occurred in many Eurozone countries, such as Greece and Portugal, and have slowed down the economy in the Eurozone and endangered the financial system, not only in Europe but globally.

For example, the sovereign debt problems in Portugal, Ireland, Italy, Greece, and Spain (PIIGS) significantly impact the whole Eurozone economy negatively, and no single member country can be immune from this sovereign debt crisis, because of the unified currency and highly linked market via trade in the Eurozone countries. When one member suffers a sovereign debt issue, the rest of the members have to pay for the consequences (Lane, 2012). The Eurozone members have paid more than 320 billion U.S. dollars to help Greece's sovereign debt (see Table 1.1) during the recent European sovereign debt crisis.

In the case of Greece, the first two bailout packages made by Eurozone member states and the IMF were worth 110 billion Euros and 164 billion Euros in 2010 and 2011, respectively(Spiegel, 2013) (see Table 1.1). However, according to the European Stability Mechanism (ESM) report (cited by Spiegel, 2013), due to the recent sovereign rating and the global economy not recovering rapidly (according to World

Bank data, the global growth rate decreased from 4.3% in 2010 to 2.5% in 2015), Greece was not able to raise enough money by selling sovereign debt in the open market in 2014 to keep the country from a sovereign default. As a result, a third bailout (USD96 billion) was made in 2015. Differently from the last two bailouts, the IMF was not involved in the third bailout package (A third bailout gets the green light, 2015).In spite of the third bailout, the Eurozone financial ministers agreed to extend the repayment period and cap the interest rate for the first two bailouts (Greece bailout: Eurozone deal unlocks 10.3bn euro, 2016).

The bailouts in Greece significantly impact the other Eurozone countries and the credit risk may spillover to other EU members such as Portugal, Italy, and Spain. According to Augustin, Boustanifar, Breckenfelder and Schnitzler (2016), the spillover effects of the credit risk spread from Greece to the whole Eurozone. The authors' study found a strong link between sovereign risks in Greece and credit risks in the EU and the authors believed that after the first bailout, a ten percent increase in sovereign credit risk in Greece would increase the corporate credit risk in the Eurozone by 1.1 percent.

Table 1.1 Bailout Packages to Greece in U.S. dollars

From Eurozone countries (billion)	From IMF (billion)	Total (billion)
Package one (2010)		
80	30	110
Package two (2012)		
145	19	164
Package three (2015)		
96	0	96

Source: German Finance Ministry, 2016

Sovereign risk can potentially spread to financial institutions, particularly banks when the value of collaterals that the banks hold in sovereign debt is reduced (Babecky et al., 2012). Babecky et al. (2012) investigated bank, debt and currency risks based on quarterly data in 40 advanced countries from 1970 to 2010 and found that sovereign risk impacts bank risk through fundamentals such as GDP growth and credit risk. In addition, sovereign defaults directly harm the value of the government bonds and loans that banks' hold, which significantly impacts banks' risk. This is true for banks with large numbers of government bonds. For example, Angeloni and Wolff (2012) investigated the bank stock market value dynamics and found that banks' market performances were strongly affected by the sovereign debt holdings of Portugal, Ireland, Italy, Greece and Spain (PIIGS) during the European debt crisis period. For example, the major drop in the banks' stock market value in July to October 2011 was attributed to the Greek debt holdings; Italian and Irish sovereign exposures significantly impacted the banks' performances in October to December 2011. As a result, the authors believe there is a strong linkage between sovereign debt risk and bank performance. When the sovereign debt level is high, the default risk of government loans will be questioned; the sovereign risk may cause panic selling and devalue government bonds, which significantly impact the asset value of the banks that hold a large amount of government debts (Kiyotaki & Moore, 2005). Similarly, Kaminsky, Reinhart and Vegh (2003) studied the contagious and financial linkages between financial sectors such as sovereign debt and bank sector and found that sovereign risk can significantly impact bank risk. The authors argue that negative

shocks in one market can directly impact the collateral values and cash flows associated with securities in other markets such as the bank sector.

Reinhart and Rogoff (2010) tested the relationship between debt and bank crises of the world's financial markets from 1970 to 2009 and confirmed that sovereign debt and bank crisis tend to occur together. Their study suggests that once the government decides to roll over the sovereign debt, the cash flow of these banks will be significantly affected. The authors further emphasized that even if banks do not hold much government debt, the sovereign ceiling may make the banks' offshore borrowing quite costly or even impossible. As a consequence, a sovereign debt crisis can easily lead to a bank crisis (Reinhart & Rogoff, 2010). Similarly, Blundell-Wignall and Slovik (2011) investigated the impact of sovereign debt risk on bank risk during the 2010 European debt crisis. The authors observed a 30% to 50% haircut on the sovereign debt asset value loss for banks which held heavy sovereign debt of PIIGS countries. The authors concluded that sovereign default potentially decreases banks' performance.

1.2Background

Table 1.2 Total Central Government Debts of China

	Government debts (Trillion RMB)
2006	5.37
2007	5.65
2008	7.49
2009	7.12
2010	8.19
2011	16.98
2012	15.67
2013	15.29
2014	14.26
2015	16.85

Source: National Bureau of Statistics of China, 2016

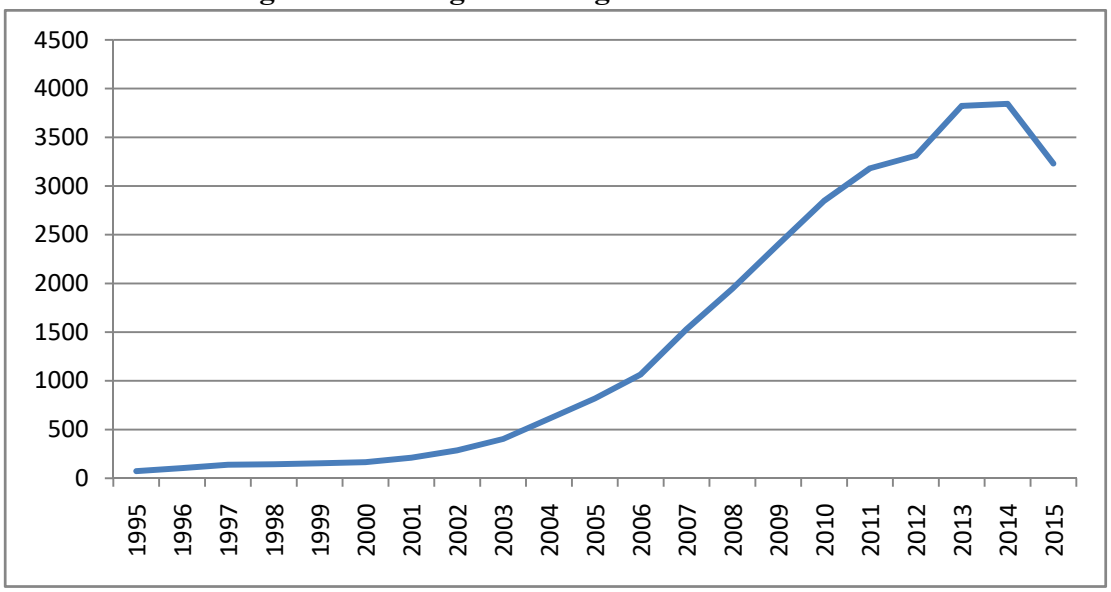
The government debts of China have increased dramatically in the last ten years (see Table 1.2); resulting from China issuing a lot of government debts in recent years, especially after the global financial crisis in 2008. For example, in the State Council Standing Committee meeting on the 9th of November 2008, the Chinese Government implemented an RMB4 trillion economic stimulus package in transportation and infrastructure areas (PricewaterhouseCoopers, 2008). This stimulus package is equivalent to USD586 billion; however, in the package, the central government only provided RMB1180 billion (USD172 billion) leaving local governments and banks to fund the rest (Dyer, 2008). Owing to the cash shortages (there is a large gap between tax revenues and expenditure to meet the 4 trillion stimulus plan), local governments such as those of Sichuan and Jiangsu, hold massive debtstotallingRMB64.51 billion and RMB770.6 billion, respectively (Zhang, 2013a). According to a JP Morgan report in 2013, China's total debt to GDP ratio was 187% at the end of 2012; this reached282%

in 2015. This ratio only numbered 105% in 2000. The rapid rise in China's government debt ratio implies a higher probability of a debt crisis occurring in China. According to *The Economist* (2016), debt expanded twice as fast as the economy in China and the massive growth of debt created liquidity and bank risks. For example, in 2015, USD65 billion worth of bank loans turned bad and USD600 billion in capital has left China. These suggest a large negative impact of debt to GDP ratio increasing in China. Similarly, Reinhart and Rogoff (2010) suggested that borrowing surges (massive amounts of borrowing taking place in a short period) potentially signal that a crisis is not too far away. The authors studied total government debt in emerging countries from 1970 to 2009 and confirmed that a large increase in the debt to GDP ratio was one of the determinants of the sovereign crisis. Researchers from the World Bank investigated the sovereign risk based on a data set of 101 countries from 1980 to 2008 and found that debt to GDP is one the important determinants of sovereign risk. The authors believe that the threshold level of the debt-GDP ratio is around 77%; once the ratio exceeds 77%, a 1% increase in the debt-GDP ratio will decrease real economic growth by 0.02%, which negatively impacts the sovereign risk (Caner, Grennes & Koebler-Geib, 2010). Therefore, the high debt-GDP ratio potentially can lead to a sovereign risk problem in China.

It is interesting that the sovereign debt ratio is very high in China when the country is considered one of the richest countries in the world. China's foreign exchange reserves totalled USD3.5 trillion in June 2013, and this jumped to 3.66 trillion US dollars in just three months at the end of September (Silk, 2013).By the end of

January 2016, China's foreign exchange reserves reached USD3.23 trillion. The rapid increase started when China opened up to outside markets in the 1990s. Owing to the comparative advantage in prices, the large growth of foreign exchange reserves is attributed to success in China's exports (Yueh, 2013).The author believes that the comparative price advantage of "made in China" products creates a large demand for China's manufactured goods, which strongly increases the exports that far exceed the imports. This generates an instant cash inflow in foreign currency which significantly increases the foreign exchange reserves in China (see Figure 1.1).

Figure 1.1 Foreign Exchange Reserves in China



Source: National Bureau of Statistics of China, 2016

However, holding a large amount of foreign currency is not helping China to avoid its debt problems. The 2008 US sub-prime loan crisis negatively impacted global markets, and the failure of many investment banks in Wall Street and the bailout of Fannie Mae and Freddie Mac caused creditors to lose confidence and create panic sale behaviour, which harmed the financial system globally. This global recession

decreased the international trade globally, which significantly impacted China's exports. For example Table 1.3 shows that the exports in China experienced a significant decrease from the beginning of 2009, and net exports decreased by 16%.The decrease in exports reduced the economic growth in China and, in order to sustain growth in the economy, a massive stimulus plan was implemented by the Chinese government in 2008. However, this plan sunk RMB40 billion into projects that generated little return such as the high-speed rail project (Hinds, 2013). As a result, about three-quarters of the government debts that matured at the end of 2012 could not be paid so China's banks issued a 428 billion US dollars bailout via a massive rollover scheme to avert local government defaults (Rabinovitch, 2013).

Table 1.3 China's Export Dynamics 2008-2009

	Export Growth (%)	Net Growth (%)
1/2008	26.7	26.6
2/2008	6.5	16.8
3/2008	30.6	21.4
4/2008	21.8	21.5
5/2008	28.1	22.9
6/2008	17.6	21.8
7/2008	26.9	22.6
8/2008	21.1	22.4
9/2008	21.5	22.2
10/2008	19.2	21.9
11/2008	-2.2	19.3
12/2008	-2.8	17.2
1/2009	-17.5	-17.5
2/2009	-25.7	-21.1
3/2009	-17.1	-19.7
4/2009	-22.6	-20.5
5/2009	-26.4	-21.8
6/2009	-21.4	-21.8
7/2009	-23	-22
8/2009	-23.4	-22.2
9/2009	-15.2	-21.3
10/2009	-13.8	-20.5
11/2009	-1.2	-18.8
12/2009	17.7	-16

Source: National Bureau of Statistics of China, 2010

1.3Research problem statement

The debt problem generated a serious liquidity problem in China owing to a large amount of government debt rollover. For example, the interbank overnight lending rate (SHIBOR) reached 13.44% in June 2013; at the same time, the interbank overnight repo rate exploded to 25%, which suggests that China's interbank market nearly froze in mid-2013 due to a money shortage (Zhang, 2013b).Consequently, large numbers of banks temporarily stopped lending to businesses and individuals from June to mid-July 2013 (Li, 2013). Further, many companies received requests about tightening loan repayment schedules and a number of banks (such as the Industrial and Commercial Bank of China and the China Minsheng Bank Co., Ltd) even refused to renew any existing loans (Zhang & Han, 2013). This implied that the liquidity problem was potentially spreading from the financial sector to the real economy.

Owing to the large amount of foreign exchange reserves, an option available to China's government is to raise money from the exchange market by selling the foreign currencies. By doing so, the government would be able to repay the sovereign debt in order to release the pressure of the money shortage in the financial market. However, such action would result in a series of negative consequences. Selling foreign exchange reserves will increase the exchange rate of the RMB against other currencies, which raises the prices of products made in China. This will impact China's export negatively (Thorbecke, 2011), which could potentially damage the

Chinese economy. According to a report by PricewaterhouseCoopers (2008), the export dependency ratio (total exports over GDP) in China is around 40%. Consequently, a drop in exports will significantly impact China's economy. For example, the GDP growth of China in 2007 was 11.9%. Further, exports decreased from 2008 to 2009 (see Table 1.3) and China's GDP growth decreased to 9.4% in 2008 and 7.5% in 2009 (PricewaterhouseCoopers, 2008).Figure 1.2 shows the similar trend of GDP growth rate and exports in China in recent years, which implies that the decrease in exports will significantly drive down the economic growth of China. In summary, exports will be negatively impacted by the increase in the exchange rate once the Chinese government decides to sell its foreign reserves (Thorbecke, 2011), which further reduces economic growth in China leading to loan repayment difficulties due to the decrease in tax revenue. Therefore, selling foreign reserves is not a good option.

Figure 1.2 Dynamics of the GDP Growth Rate and Exports in China

Source: National Bureau of Statistics of China, 2015

Similarly, increase in money supply – M2 is also not a smart choice either as the increase in the money supply will generate a higher inflation rate. Rajkumar (2011) tested the long run relationship between money supply and inflation in India from 1935 to 2009 and found that money supply has major effects on growth in the price levels, which implies that an increase in the money supply may lead to an increase in inflation. Similarly, Lavern, Wayne and Gooboon (2006) studied the impact of money supply on inflation and public debt in 71 countries from 1963 to 2004 and concluded there is a strong link between money supply and inflation. Banks' collateral would be devalued with increasing inflation. As a result, increase money supply may potentially lead to a bank crisis in China.

The aim of this study is to investigate whether a sovereign debt problem exists in China and the consequences and impacts of such debt on the country's economy.

1.4 Research objectives:

The objectives of this study are:

- To investigate whether a sovereign debt problem is occurring in China
- To examine the determinants of China's sovereign debt risk
- To study the link between the bank risk and sovereign debt risk in China's financial market

1.5 Research contributions

First, since the outbreak of the sovereign crisis in Europe, many researchers have paid attention to the government debt issue in Europe. For example Lane (2012) claimed that the European debt crisis was due to the high debt to GDP ratio. Cottarelli (2012) found that, besides the debt burden, the unified currency policy in the Eurozone was another important contribution to the Eurozone debt crisis. Cui (2012) further explained that the unified monetary policy in the EU switches off the opportunities for governments to use monetary tools to adjust the respective country's economy, which may cause the government policies to be ineffective and lead to the Eurozone debt crisis. Mody and Sandri (2012) reported that the Eurozone debt crisis significantly impacted the banking sector in the EU and the losses (30%-50% haircuts on the sovereign debt assets value) from bad loans of EU banks increased during the debt crisis period. However, there are limited empirical studies in international literature about the sovereign debt risk in China. As a result, one of the goals of this current study is to empirically test the potential sovereign debt risk and its determinants in China.

Second, majority of the existing literature only focus on the impact of debt burden and debt level on sovereign debt risk due to the significant increase in sovereign debts in China since 2008 (see Hou et al., 2012; Fan & Lv, 2012 and Li, 2012). Hou et al. (2012) focused on the imbalance between the investment and consumption of China which suggests an unhealthy economic condition exists in China (see Section 2.7).

Fan & Lv (2012) and Li (2012) discussed the increasingly large amounts of central and local government loans in China which may far exceed the debt affordability of Chinese governments (see Section 2.6).However, other economic fundamentals such as debt affordability and debt interest rate also impact the sovereign debt risk (see Cole and Kehoe, 1996; Fuertes & Kalotychou, 2007 and Yue, 2010).For example, Yue (2010) studied the sovereign default and debt renegotiation for emerging countries in Latin America and found that the debt interest rate significantly increases the cost of debt which may lead to sovereign default. Further, Fuertes and Kalotychou (2007) claimed that debt affordability is one of the important determinations of a sovereign debt crisis based on the study of 75 emerging countries from 1984 to 2000. This is due to debt affordability (debt-revenue ratio) which shows the ability of a government to repay loans. As a result, the current study will focus on the impacts of economic fundamentals including not only GDP, government debts, and debt burden but also debt affordability and the interest rate on the sovereign debt risk.

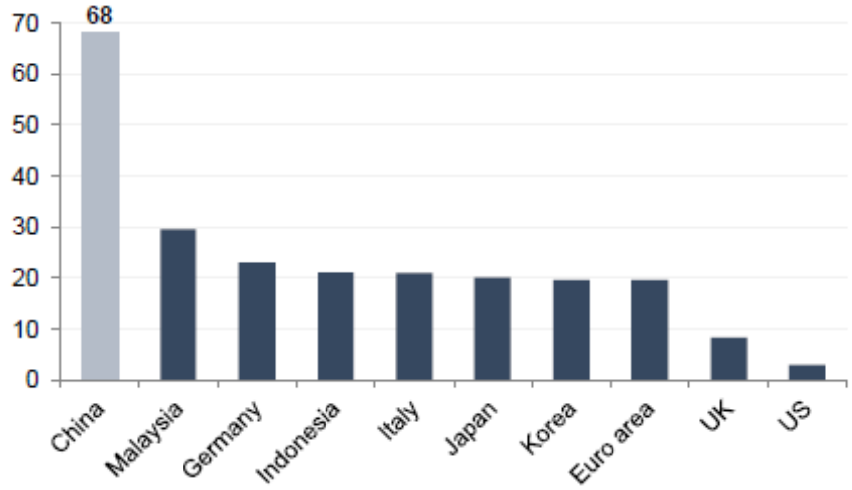
Third, most of the literature investigates the foreign currency government debt default such as 1980s Latin American debt crisis and 2010 European debt crisis. However, there are limited empirical studies on sovereign debt risk in a country where domestic debt almost occupies the total government debts; the domestic sovereign debt risk seems to be ignored in the international literature. Our study contributes to the literature in investigating sovereign debt risk in a country without any foreign currency sovereign debt problem (the extremely small proportion of foreign-total sovereign debt ratio, <1%, and the amount of foreign reserves in China far exceeds

the amount of foreign currency government debt). In addition, the S&P sovereign ratings is one of the indicators that has been widely used to study sovereign debt risk in a country; however, S&P sovereign ratings is normally used to determine foreign currency sovereign debt risk in the literature. This study attempts to test the suitability of using S&P sovereign ratings in determining government domestic debt risk in China.

Forth, extant of the literature has widely addressed the impact of a sovereign debt problem on a country's financial sector such as the banking system. According to Arteta and Hale (2008), sovereign debt risk will significantly impact the banks regardless of whether the banks hold a large amount of sovereign debts (also see Reinhart & Rogoff, 2010). Blundell-Wignall and Slovik (2011) provided similar results in studying the relationship between bank risk and sovereign risk during the current Eurozone debt crisis. The authors observed a 30% to 50% haircut on the sovereign debt asset value loss for banks that held heavy sovereign debt of PIIGS countries, which suggests the strong link between sovereign risk and bank performance. However, the sovereign debt market and banking system in China are very different compared with other countries, such as European countries, that been studied widely. First, different from the European countries and many other countries which have a relative low share of government bonds held by banks, more than 65% of the Chinese government debt is purchased by Chinese commercial banks (see Figure 1.3). Second, there is a limited number of foreign commercial banks operate in China, and there are many restrictions on the foreign commercial banks' spending in

China. Third, the big four commercial banks in China, which are owned by the Chinese government, occupy more than 70% of the market share of the commercial banks in China. These suggest the significant difference in the sovereign debt market and banking system between China and many other countries in the literature. Thus, our study aims to investigate the impact of sovereign debt risk on the banking system, particularly government-owned and non-government-owned commercial banks in China.

Figure 1.3 Share of Government Bonds Held by Banks as of September 2016 (%)



Source: AsiaBondsOnline, ECB & US Treasury, 2016

1.6 Structure of the Thesis

The thesis is organized as follows. Chapter One introduces the overview of the research problem statement, objectives and background information. Chapter Two reviews the literature on the sovereign debt issues globally and the current sovereign debt of China. Chapter Three discusses the data and research methodology used in the study. Chapter Four presents the empirical results and findings. Chapter Five

concludes the research findings and discusses policy implications, limitations, and recommendations for future research.

Chapter 2

Literature review

2.1 Introduction

Reinhart and Rogoff (2010) define the debt crisis as an outright default, repudiation or restructuring of debt that causes a significant decrease in the credit supply. A debt crisis is potentially accompanied by a liquidity crisis, currency crisis (Arteta & Hale, 2008) and bank crisis (Reinhart & Rogoff, 2010). According to Arteta and Hale (2008), a debt crisis exhibits a negative sign in the capital market, the lenders will certainly reconsider their current debt contract and further lending risk and as a result, capital will be extremely short in the open market which may lead to a liquidity crisis. The authors also claimed that a currency crisis may happen during a debt crisis because in a debt crisis foreign investors may decide to leave the market. These will significantly impact the exchange rate and devalue the country's currency, which ultimately leads to a currency crisis. Banks which hold massive government bonds will experience losses if the country suffers from a debt crisis. This then leads to a banking crisis (Reinhart & Rogoff, 2010). For example, the 1980s' Latin American debt crisis included the banking crisis and the currency (Peso) crisis, which will be discussed in this chapter.

Historically, sovereign debt crises have occurred many times with most occurring in Latin American countries (for example Argentina and Mexico). For example, Argentina experienced sovereign debt defaults in 1982 and 2001 and restructured its

sovereign debts in 2005, 2007, and 2010 and Mexico faced similar sovereign debt difficulties in 1982 and 1994. The most serious sovereign debt crises, in terms of the deep and wide impacts of sovereign crises, occurred in Latin American and European countries (Greece, Ireland, Italy, Portugal and Spain).

This chapter discusses previous studies on debt crises primarily in Latin American and European countries. Section 2.1 introduces the definition of a debt crisis and the 1980s' Latin America debt crisis. Section 2.3 presents the literature on other debt crises in Latin America. Section 2.4 lists the studies on the 2010 European sovereign crisis and Section 2.5 discusses the impacts of sovereign debt risk. Section 2.6 addresses the Asian experience of the debt issue and the current sovereign debt problem in China.

2.2 Latin American debt crisis

Latin American countries experienced a series of debt crises in the 1980s which started in August 1982, when Mexico first announced a default on its foreign debt payment. From that period, the contagion of Mexico's debt default spread to other Latin American countries such as Brazil, Venezuela, Argentina, Bolivia and Peru, which were also unable to repay their debts. This contagion of the debt crisis spread fast because of the similar strategy of Latin American countries where they borrowed from developed countries to pay off old loans. If foreign creditors stop renewing the loans, this strategy will drive Latin American countries into a debt crisis. According to Marlene (1989), the total external debt that Latin American countries held numbered

420 billion US dollars and the interest on those loans totalled as high as 235 billion US dollars in 1982. The larger the amount of sovereign debts the higher the debt burden (debt-GDP ratio) and the lower the debt affordability (debt-revenue ratio), which increased the sovereign risk of Latin American countries. In addition, the high interest on sovereign loans lowered the ability of Latin American governments to repay loans. Consequently, the sovereign debts of Latin America became risky and as a result, the U.S. decided to stop their loan roll-over for Latin American countries. These led to the 1980s' Latin American debt crisis.

According to Kaminsky and Pereira's (1996) study, after the onset of the debt crisis, the Latin American countries experienced a hard time, known as the "lost decade". The authors' data showed that the 1980s' Latin American debt crisis resulted in a decrease in the average economic growth of the region from 6 percent in the 1970s to 1.8 percent in the 1980s. The significant drop in economic growth was accompanied by a dramatic rise in inflation. The "lost decade" for Latin American countries was due to a dramatic drop in economic growth in the 1980s. For example, according to Levy-Livermore's (1995) study, during the first two years of the 1982 Latin American debt crisis (1982-1983), the average economic growth of Latin American countries has decreased by 16 percent every year (see Table 2.1). In Table 2.1, we can clearly see that the economic growth of these countries experienced a major decrease from 1982 to 1985 while the external debts exhibited an increasing trend during the whole period (1971-1987). Therefore, Bertola and Ocampo (2012) believe that the 1980s' Latin American debt crisis is because of the imbalance of international trade which

leads to increasing external debts and the government being unable to afford the interest.

Table 2.1 Total External Debt and Economic Growth Rate in Latin America 1971-1988

Year	Total external debt in 1980 US dollars	Economic growth rate
1971	60.6 billion	7%
1972	69.7 billion	8.2%
1973	77.2 billion	19.4%
1974	92.6 billion	21.1%
1975	101.5 billion	-2%
1976	117.9 billion	5%
1977	166.9 billion	0.1%
1978	191.9 billion	8.6%
1979	214.5 billion	9.6%
1980	242.7 billion	9.3%
1981	270.5 billion	4.1%
1982	285.8 billion	-16%
1983	297.9 billion	-16%
1984	300.1 billion	-1%
1985	300.8 billion	-1%
1986	308.1 billion	0.6%
1987	325.1 billion	8.4%
1988	302.1 billion	13.5%

Source: World Bank Group, 1990

Levy-Livermore (1995) further discussed that, before the Latin American economy started to recover in 1986, the economic growth dropped 34 percent from 1982 (from 1982 to 1986) which is approximately equal to the economic growth of Latin America from 1976 to 1981 (see Table 2.1). This suggests that the Latin American debt crisis knocked back the Latin American economy for about 10 years (1976-1986). According to Bertola and Ocampo (2012), this is because external debts mainly drove economic growth in Latin American countries during the 1970s. Therefore, when foreign investors started to leave the Latin American markets in 1982 (over 6% of

GDP outflows per year during the period from 1982 to 1987), the economic growth of the countries crashed.

Kaminsky and Pereira (1996) analyzed a panel data of 33 debtor countries (mainly Latin American countries) and provided empirical evidence to support the debt overhanghypothesis and concluded that the debt crisis can easily lead to economic growth collapse. According to the authors' study, the sovereign debt problem encouraged creditors to leave the country which created large outward resource transfers. Part of the return to investment was taken away from the domestic economy to pay foreign creditors. As a result, these outward transfers imposed a disincentive for investment and economic growth in the debtor economies. This impact is known as a panic sale in which a number of creditors leave the market and others follow. According to Borensztein (1990), if a country has to transfer 5% of GDP outwards (for example to repay debts or interest) and is unable to borrow in the international credit markets during the period, then investment and consumption will decrease about 1.8% and 2.6%, respectively. This explained why the 1980s' Latin American debt crisis was more serious in Argentina, Mexico, and Venezuela, since these countries were the first to adopt financial liberalisation in the 1970s. According to Kaminsky and Pereira (1996), financial liberalisation allows capital freedom to move between markets without regulations; thus, the adoption of financial liberalisation prevents the government controlling capital movements. Consequently, the massive capital outflow in Argentina, Mexico, and Venezuela significantly decreased the countries' investment and consumption, which additionally increased the impact of

the 1980s' Latin American debt crisis on the countries' economies.

Krueger (1987) studied the 1980s' debt crisis in developing countries such as Argentina, Peru, Brazil, Mexico, etc. in order to trace the origins of the debt crisis. Regardless of the external shock, including the increase in oil prices since 1979 and the extremely tight monetary conditions, leading to a dramatic decrease in exports, the author pointed out that the increase in debt to GDP and external debt to export ratio also significantly contributed to the debt crises. First, an increase in debt to GDP ratio suggests an increase in the countries' debt burden. A higher debt burden creates a higher sovereign debt risk. Second, an increase in the debt to export ratio implies external debt increases much faster than exports; external debt decreases much more slowly than exports, or even worse, external debt increases while exports decrease. These can potentially lead to a country's lack of foreign reserves to repay the external debt and resort to selling domestic currency to repay such debt, which further creates large pressures on the currency exchange market. As a result, the higher debt burden will not only increase the risk of a debt crisis, but also harm the currency exchange price (Krueger, 1987).

Reinhart and Rogoff (2010) also confirmed that the debt surge is an important signal of crises approaching. By testing the origin of debt crises over 70 countries, the authors confirmed that a debt surge increased the government's debt burden and weakened the sovereign debt sustainability, because the debt surge creates large pressures on the country' interest repayments. For example, the total interest of the

external loan in Latin American countries was as high as 235 billion US dollars in 1982. Evidence of a debt surge occurred during the pre-crisis period in Argentina where the external debt to GDP ratio of Argentina in 1975 was 18.6%. This ratio increased to 30.2% in 1979 and further increased to 60.3% in 1982 and finally caused a debt crisis (Reinhart & Rogoff, 2010).

According to Cardoso (1991), Brazil also suffered the pain of the 1980s' Latin American debt crisis. The author reported that Brazil experienced hyperinflation when the debt crisis spread to Brazil. During the 1980s' Latin American debt crisis period, Brazilian inflation rates increases dramatically. Brazil's inflation was 1.5% per month before 1980 and increased to 6% per month in a short period (from 1980 to 1982), which suggests that the Brazilian economy had begun to weaken. Following the Latin American debt crisis in 1982, Brazilian inflation increased to 10.5% per month, which then caused the Brazilian economy to crash (for example the economic growth of Brazil decreased by 7.2% from 1981 to 1983). Brazilian inflation kept increasing in the 1980s and reached as high as 50% per month in December 1989 (Cardoso, 1991).

2.3 Other individual debt crisis in Latin America

Beyond the 1980s' debt crisis, some other individual debt crises also occurred in Latin American countries such as Argentina and Mexico.

2.3.1 Argentina

Argentina is one of the four largest Latin American countries. Its GDP in 2014 was

USD540.2 billion which made it the third largest economy in Latin America, followed by Brazil and Mexico. Argentina had experienced a series of debt defaults such as those in 1982 (see Section 2.1) and in 2001 (Reinhart, 2010). In December 2001, the Argentinean government defaulted on a 97.6 billion US dollars debt which was the largest sovereign debt default in history before 2012. Many researchers have been intrigued with the debt crises in Argentina, including Monteleone (2013), Datz (2012) and Helleiner (2005).

According to Monteleone (2013), Argentina has experienced a more than ten-year default on its debt since December of 2001. In particular, Argentina restructured its debt in 2005, 2007 and 2010; however, around 6.8 billion US dollars worth of government debts still remained in default in 2013. Datz (2012) studied the Argentine debt history of the pre-crisis and crisis periods from 1993 to 2010 and found that the sovereign debt problem significantly impacted the national welfare where the pension funds hold large amounts of sovereign debt. According to the author's study, while the reform in 1993 ended the external sovereign debt default after 1982 (also see Reinhart, 2010), the Argentinean government established private pension funds. Since then, the pension funds have become an important source of credit for the government of Argentina. Rofman (2012) also confirmed that, owing to the lack of alternatives and the high yields of government bonds, the pension funds of Argentina purchased a large amount of Argentina's sovereign debt (see Table 2.2). The weight of government bonds in the total assets of Argentine pension funds was 40.89% in 1997; however, this number increased to 75.3% in 2002, just after the government announced its

default on sovereign debt in December of 2001. Consequently, Argentina's pension funds suffered huge losses, which made the pension funds nearly default until they were reformed in 2007.

Table 2.2 Weight of Government Bond in the Portfolio of Pension Funds in Argentina 1997-2006

Year	Weight
1997	40.89%
1998	47.98%
1999	48.84%
2000	49.10%
2001	61.53%
2002	75.30%
2003	67.98%
2004	60.05%
2005	55%
2006	54%

Source: SAFJP, 2007

Boonman, Jacobs and Kuper (2013) observed the debt crises of the four largest Latin American countries including Argentina, from 1870 to 2012 in order to establish a sovereign debt index to measure the likelihood of a sovereign debt crisis. The authors believed that regardless of external shocks, the debt to GDP ratio and the export to import ratio are important determinants of debt crises. According to the authors, the debt to GDP ratio captures the debt burden for a country, and the export to import ratio is one of the key estimators for a country' debt affordability. As a result, these two fundamentals capture the ability for external loan repayments.

The 1980s' Latin American debt crisis brought hyperinflation to Argentina (see Table 2.3). During the debt crisis period from 1982 to 1991, there was an average three-digit inflation rate (over 700%) in Argentina. To deal with hyperinflation, Argentina's

government introduced a currency board system in April 1991 (Kitano, 2005). The currency board is a system that requires the central bank to hold international reserves, which equal no less than 100 percent of their monetary base. According to the author's study, although Argentina's central bank had prepared enough foreign reserves to respond to arbitrary withdrawals, it could not avoid a currency crisis in 2002. The author found that the rapid accumulation of the debt level fuelled a currency crisis. This is because a debt surge creates large pressure on interest payments in the following years. The large interest repayments required more foreign reserves which increased the demand for foreign currency, which led to a devaluation of the Argentine Peso. The devaluation of the currency can easily start a currency crisis.

Table 2.3 Inflation Rates in Argentina 1982-1997

Year	Inflation Rate (%)
1982	164.8
1983	343.8
1984	626.7
1985	672.2
1986	90.1
1987	131.3
1988	343
1989	3079.8
1990	2314
1991	171.7
1992	24.9
1993	10.6
1994	4.2
1995	3.4
1996	0.2
1997	0.5

Source: World Bank, 2014

2.3.2 Mexico

Similarly to Argentina, Mexico, another major country in Latin America, has also suffered several debt crises since the 1980s' Latin American debt crises. Owing to the devaluation of Mexico's Peso in 1994, credit cost was extremely high (Gil-Diaz, 1998), which caused Mexico's inability to roll over the government debt. According to the author, the devaluation of the Mexico Peso led a massive capital outflow from Mexico, where creditors started to leave the Mexican capital market to avoid exchange rate losses. This caused a liquidity problem in the credit market that led to increases in the price of credit. As a result, the cost was too high for the Mexican government to roll over its debts. Cole and Kehoe (1996) explained that, because they feared that the Mexican government would be unable to service its debt coming due, investors were unwilling to purchase new Mexican government bonds. Thus Mexico was forced into debt default. The authors further studied the origin of this panic and found that the maturity of debt also had an impact on the debt crisis to some extent. For example, while Mexico defaulted on its debt in December 1994, the average maturity of Mexico's domestic debt was extremely short, which was about 200 days. At the same time, however, the debt to GDP ratio, which was considered as the major determinant of debt crises, was at 37.4 percent much lower than that of some other non-default countries (see Table 2.4). Thus, the author concluded that extremely short average sovereign debt maturity may potentially increase the sovereign debt risk of the country.

Table 2.4 Debt to GDP Ratio for Selected Countries 1991-1994

	1991	1992	1993	1994
Mexico	45.8	35.1	35.0	37.4
France	41.1	45.6	52.9	56.8
Germany	42.7	47.3	51.8	54.6
Italy	103.9	111.4	120.2	122.6
Greece	81.7	88.6	117.1	119.8

Source: IMF, 1995

2.4 European Debt Crises

Most recent debt crises have occurred in Europe, and the sovereign debt problem became a popular topic among economists. The collapse of Lehman Brothers in September 2008 marked the start of the global financial crisis. Its impacts, however, can be traced back to as early as August 2007 when major European banks exposed their losses in the U.S. asset-backed securities market (Acharya & Schnabl, 2010). The 2008 global financial crisis deeply shocked Europe in 2008 and 2009, and brought debt crises into European Union member countries.

According to Mody and Sandri (2012), the increase in bank-sector losses on bad loans had a negative impact on sovereign bond values in the Eurozone countries; and some European Union member countries, such as Greece, Ireland, and Spain, reported an unexpected rise in deficit in GDP ratios. In particular, Lane (2012) gave an example of Greece where the budget deficit forecast for 2009, announced in October 2009, was 12.7 percent more than double the previous estimate of 6 percent. The unexpected rise in deficit increased the short-term risks of Greece. For example, the 2008 global financial crisis caused a sudden stop in the global credit market, which decreased the

credit supply globally. This required the governments of all the nations of the world to decrease their deficits to cope with difficult times; however, Greece failed to decrease its deficits, which hurt the Greek economy and ultimately resulted in sovereign debt difficulties. Lane (2012) argued that a large and sudden capital outflow would lead to a decrease in asset prices and an increase in the unemployment rate.

Portugal, Ireland, Italy, Greece and Spain (PIIGS countries) had sovereign debt problems that strongly impacted the economic growth of the Eurozone, and made all European Union members pay for the consequences. For example, Table 1.1 shows a total USD274 billion bailout that has already been paid out by European Union members and the IMF to Greece from 2010 to 2012 and over 80% of these bailouts (USD225 billion) were made by Eurozone members. This strongly impacts the EU and slows down the economic growth of the Eurozone (William, 2013). However, according to the European Stability Mechanism (ESM) report, owing to the recent sovereign rating and the global economy not recovering rapidly (Spiegel, 2013), Greece was not able to raise enough money by selling sovereign debt in the open market in 2014. As a result, Eurozone financial ministers decided to bailout Greece a third time valued at USD96 billion and extended the repayment period for the existing loans (Greece bailout: Eurozone deal unlocks 10.3bn euro, 2016).

Lane (2012) explained why such debt crises occurred in PIIGS countries, but not in other European Union members. According to Lane, the extremely high increase in the sovereign debt to GDP ratio (for Italy, Greece, Ireland, and Portugal) and the

domestic credit to GDP ratio (for Ireland, Portugal, and Spain) played an important role in leading to a debt crisis. For example, according to Table 2.5, PIIGS countries experienced a high increase in the debt to GDP ratio during the pre-crisis period (the debt to GDP ratio increased by 11.3% for Greece from 2007-2009, 14.8% for Italy from 2007-2009, 55% for Ireland from 2007-2010 and 32.7% for Portugal from 2007-2010). During the same period, the debt to GDP ratio in Germany only increased by 6.8% (from 2007 to 2009). Table 2.6 shows the domestic credit to GDP ratio of PIIGS countries has increased by over 30% since 2006, while this number did not significantly change in Germany. In addition, the government debt to GDP ratio of PIIGS countries and Germany changed little from 2001 to 2006; however, the ratio of PIIGS countries have dramatically increased since 2007 (see Table 2.5). By the end of 2014, the government debt to GDP ratios of PIIGS countries were at least 50% higher than the ratios in 2006, the ratio of Ireland particularly was around 4 times higher than that in 2006. As a result, Lane (2012) believed that the debt to GDP ratio is one of the important determinants of sovereign debt crises.

Table 2.5 Government Debt-GDP Ratios of PIIGS Countries Compared with Germany 2001-2014

Year	Greece	Italy	Ireland	Portugal	Spain	Germany
2001	127.9	117.9	37.2	59	54.5	38.1
2002	128.9	115.2	35.5	63.3	53	39.3
2003	124.3	110.8	34.2	64.9	48.3	41
2004	128.1	110.6	32.7	67.4	47.3	43
2005	125.4	112.8	33	70.3	38.5	44.7
2006	128.5	109.1	29.2	69.4	34	43.5
2007	125.6	104.3	28.7	67.5	30.1	40.8
2008	121.3	107.2	48.6	78.9	34.2	43.1
2009	136.9	119.1	67.0	91.1	46.1	47.6
2010	132.4	114.7	83.7	100.2	53.6	53.8
2011	111.1	108.3	110.0	102.4	61.8	53.4
2012	165.5	127.0	130.5	133.9	83.5	55.2
2013	181.9	134.9	133.0	138.0	96.5	52.3
2014	178.8	156.2	125.4	150.6	117.9	82.2

Source: World Bank, 2015

Table 2.6 Domestic Credit-GDP Ratios of PIIGS Countries Compared with Germany 2001-2014

Year	Greece	Italy	Ireland	Portugal	Spain	Germany
2001	50.1	60.6	72.3	115	95.1	112.0
2002	53.3	62.2	75.9	119	99.4	110.9
2003	57.2	65.5	86.2	120.6	106.4	109.5
2004	62.3	67.9	105.4	121.1	115.7	106.1
2005	72.0	71	125.5	124.7	135.5	104.9
2006	76.3	75.9	145.5	133.4	156.1	101.7
2007	84.5	82	158.4	142.2	167.1	96.6
2008	89.3	83.9	166.7	151.7	170.2	96.4
2009	88.0	87.8	170.7	159.8	172.4	98.2
2010	111.6	93.4	135.3	155.3	170.7	88.0
2011	117.2	94.6	116.1	156.2	166	84.6
2012	116.8	94.3	113.1	152.9	154.6	83.5
2013	118.3	91	107.2	144	142.5	81.8
2014	116.9	89.3	84.9	129.8	127.4	79.6

Source: World Bank, 2015

However, Cottarelli (2012) argued that in the context of the global economy and countries, the debt to GDP ratio and the deficit to GDP ratio of PIIGS countries were not as high as compared to some other countries that did not default on their debts. The author claimed that the debt to GDP ratio of Japan (189.4) was higher than that of PIIGS countries in 2011, and the deficit to GDP ratio of PIIGS countries was lower than that of the U.K. (-7.4). Table 2.5 shows the debt to GDP ratio of PIIGS countries in 2011 was 98.72 on average, which is much lower than that of Japan (189.4). Similarly, the deficit to GDP ratios of PIIGS countries, especially for Greece (-10.5) and Ireland (-12.6), were lower than that of the U.K. (-7.4) in 2011 As a result, the author believed that the debt to GDP ratio and deficit to GDP ratio were not the only contribution to the debt crises of PIIGS countries. The reason of the recent debt crises occurred in Europe may also be because of the currency policy in the European Union. The author argued that the current currency policy in the European Union treats the Eurozone as a whole, which may not be efficient and appropriate for each single member. This is due to the unified currency policy in the EU which switches off the ability of a country to use monetary policy to adjust the country's economy. In addition, the unified monetary policy treats the EU as a whole and may ignore the differences between members, which may cause the monetary policy to be inefficient for some EU members.

Lane (2012) further explained that the difference in Euro-zone countries compared to other countries is the unified currency – the euro. According to the author's study, trading in Euros in Eurozone countries switched off the option for national currency

devaluation, which is a traditional and effective economic adjustment mechanism. Further, in the original design of the European currency union, the unified currency had to be met with a unified banking and fiscal union in the Eurozone countries which required the central banks and governments of EU members to work together and come up with a unified policy across Euro-zone countries. However, there is no significant degree of banking or fiscal union inside the EU to meet the original design. This also negatively affects Eurozone countries' economic condition.

Helleiner's (2005) study showed the export to import ratio is an important determinant of the external debts' repayment ability. Generally, a devaluation of a national currency can generate a price advantage in international trading markets where increasing export helps to service the debt. Under the 2008 global financial crisis context, the single currency policy of the EU precluded individual members from using the exchange rate to adjust the decreasing trend in exports. Table 2.7 shows the dynamics of the export to GDP ratios in PIIGS countries during the period from 2008 to 2015. Only Ireland exhibited a positive growth in the export to GDP rate (11.16%) before the Eurozone debt crisis occurred in 2010. The export to GDP ratios of the other four PIIGS countries experienced a significant drop during the period from 2008 to 2009; the average decrease in such ratio was over 14%. The reason behind the problem is that the unified currency policy switched off the option of a national currency devaluation, leading to a significant decrease in exports during the 2008 global financial crisis due to the devaluation of the US dollar that decreased the competitive price advantage of these Eurozone members. The dramatic decrease in

exports harmed the PIIGS countries' ability to repay sovereign loans (based on Helleiner (2005)'s findings), which significantly increased the sovereign risk of the countries.

Table 2.7 Changes in Export to GDP Ratios of PIIGS Countries 2008-2015

	Greece	Italy	Ireland	Portugal	Spain
2008	23.4	27	84.2	31.1	25.3
2009	19	22.5	93.6	27.1	22.7
Changes	-18.80%	-16.67%	11.16%	-12.86%	-10.28%
2010	22.1	25.2	103.1	29.9	25.5
2011	25.5	27	101.2	34.3	28.9
2012	28.7	28.6	107.2	37.7	30.6
2013	30.6	28.9	106.7	39.5	32
2014	32.7	29.5	113.7	40	32.5
2015	30.1	30.2	121.4	40.3	33.1

Source: World Bank, 2015

Similarly, Cui (2012) noted that Japan's sovereign debt burden was higher than that of European Union members and supported Helleiner's (2005) findings. According to Cui's explanation, the euro brings a unified monetary policy for all EU members. As a result, EU members are left with only fiscal policy in their hands to adjust the country's economy; the capability to manoeuvre monetary policy is taken over by the EU financial administration. Owing to the different adjustment mechanisms, fiscal policy, and monetary policy are often used together. However, changes in fiscal policy alone may not be able to adjust the country's economic condition successfully. For example, by changing monetary policy, governments can adjust the money supply to control the international trade and inflation. However, fiscal policy is mainly used to control government spending; in an inflationary economic condition, fiscal policy

may not be efficient. Further, an increase in the government spending to stimulate the economy will easily result in a heavy debt burden for the country. For example, the 2008 financial crisis negatively impacted the global economy. The PIIGS countries were unable to use monetary policy to adjust their economies and exports owing to the unified monetary policy of the EU, which resulted in a larger decrease in the exports to GDP ratio (-14%) compared with that of the EU (-11%) and the world average (-13%). The use of fiscal policy alone caused a heavy debt burden for PIIGS (Table 2.5) which led to the 2010 Eurozone debt crisis.

2.5 Iceland

In addition to the Eurozone, other European countries such as Iceland also experienced a debt crisis. The Iceland crisis in 2008 provided a frightening example of debt defaults, which led to the systemic collapse of the Icelandic banking system. Iceland governments introduced an expansionary fiscal policy after 1995 that significantly impacted inflation in Iceland. To deal with the inflation, according to Arnbjornsson and Gronvold (2009), the Iceland government increased the interest rate from 5.3% in 2003 to 15% in 2008. This significant increase led to a massive inflow of capital speculating on the interest differential between Iceland and other countries. As a result of the capital inflow, the Icelandic Krona (currency) was over-appreciated by about 30%. The 2008 financial crisis shocked the global financial market and foreign creditors stopped investing in Iceland and outwardly transferred their capital from Iceland. Consequently, the capital outflows led to the depreciation of the

Icelandic Krona. For example, the authors pointed out that the Icelandic Krona was devalued by 20% and 25% in March and June of 2008, respectively. This made the foreign debt extremely expensive in Iceland, which led to a sovereign debt default and the systemic collapse of the Icelandic banking system. Consequently, a 6 billion U.S. dollar rescue package from the IMF was needed to bail out Iceland (Duncan, 2008).

2.6 Impacts of Debt Crises

The issue of sovereign debt not only leads to a potential crisis of debt, but also may spread to other sectors of the economy. For example, the debt crisis is always accompanied by a bank crisis, a liquidity crisis and a currency crisis (see Arteta & Hale, 2008; Reinhart & Rogoff, 2010).

2.6.1 Debt and Liquidity Crises

Drudi and Giordano (2000) claimed that rational investors are risk averse. When a country falls into sovereign debt default, rational investors especially foreign investors are more likely to withdraw their capital from that market to a safer zone. Consequently, a debt crisis significantly and negatively impacts the credit market, potentially leading to a liquidity shortage. For example, the 1980s' Latin America debt crisis caused bank runs in Latin American countries due to the capital leaving the countries and devaluation of the countries' currencies. These bank runs created a liquidity problem in the Latin American countries. For example, Mexico temporarily froze citizens' bank accounts in foreign currency in order to prevent depletion of the

Mexican foreign reserves because Mexican government was unable to exchange enough credit to repay foreign debts (Cardoso, 1992).

Similarly, Reinhart and Rogoff (2010) suggested that sovereign debt defaults (especially domestic defaults) sometimes might involve the forcible conversion of foreign currency deposits into local currency or deposit freezes, which could lead to a liquidity crisis (also see Arteta & Hale, 2008; Perri & Neumeyer, 2005).

For example, Arteta and Hale (2008) studied the relationship between debt crisis and credit market in 30 emerging markets between 1984 and 2004, and successfully found systematic evidence of a decrease in credit availability in the aftermath of sovereign debt crises. The authors found that during the sovereign debt crisis, the credit availability would generally decline by more than 20% over at least two years.

Perri and Neumeyer (2005) addressed the impact of fundamental shocks on the cost of capital. The authors used a data set of 10 markets of both emerging economies (such as Argentina, Brazil and Mexico) and developed economies (such as Australia, Canada and New Zealand) and found about 27% of output losses given a sovereign default risk. The authors confirmed that fundamental shocks such as sovereign debt issues have amplified the effects on a country's credit market. This could be explained by the panic effect. According to Kiyotaki and Moore's (2005) study, an exposure to a sovereign debt problem may lead investors and creditors to start questioning the default risk of government debt. The sovereign risk may cause panic selling and devalued government bonds, which negatively impacts the credit market.

Generally, before a sovereign default has acutely occurred, the government tends to over borrow from the banking system in order to avoid or postpone debt default or restructuring. Through issuing and rolling over massive government bonds, domestic liquidity becomes extremely scarce, which could lead to an increasing demand for foreign credit for both the banking system and non-financial firms (Arteta & Hale, 2008). Further, when a country defaults or renegotiates its sovereign debt, whether or not it has been formally announced, the sovereign default risk will rise. The increase in the sovereign default risk will lead to an increase in the country's risk premium (Kiyotaki & Moore, 2005). This will dramatically impact the credit market. As a consequence, Arteta and Hale (2008) believed that a sovereign debt crisis potentially could impact the credit market by making raising credit become extremely difficult or even impossible, which suggests a liquidity shortage or crisis approaching. For example, the 1980s' Latin American debt crisis devalued the currency of all the Latin American countries and creditors withdrew capital out of Latin America and as a result, the Latin American governments were not able to borrow or exchange enough credit in the open market, which led to a liquidity crisis. Similarly, Drudi and Giordano (2000) also confirmed that sovereign debt defaults have a negative impact on the credit market and may lead to a liquidity shortage in the capital market (also see Perri & Neumeyer, 2005).

2.6.2 Debt and Bank Crises

Arteta and Hale (2008) suggest that when a country is near defaulton its sovereign

debt, the government tends to postpone debt restructuring and drain the banking system in order to service the debt, while hoping the country can avoid a debt crisis. By doing so, the government issues or rolls over massive government bonds in the domestic banks. This kind of strategy links banks' risk with the sovereign risk; once a crisis occurs in one sector it will immediately spread to other sectors. This is more so for banks that hold a large number of government bonds in which a sovereign default can significantly impact the banks' performance by decreasing the banks' profitability and assets values. For example, Blundell-Wignall and Slovik (2011) observed a 30% to 50% haircut on the sovereign debt asset value loss for banks that held heavy sovereign debts of PIIGS countries during the 2010 Euro-zone debt crisis period, which significantly impacted the banks' performance.

Reinhart and Rogoff (2010) investigated the total external debt of emerging markets from 1970 to 2009 and found that the significant increase in a country's external debt was systematically linked to both government default and a systemic banking crisis. The authors argued that this link also holds in advanced economies, for example in the U.S. the external debt to GDP ratio doubled during the 2005-2007 period which systematically contributed to the 2008 global financial crisis.

Similarly, Mendoza and Terrones (2008) investigated 22 credit booms in industrial countries and 27 credit booms in emerging economies from 1960 to 2006. The authors found that credit booms are associated with economic expansion. During the period of economic expansion, both governments and firms tend to over borrow from the credit

market which leads to an increase in credit prices. Therefore, once the economic expansion rate slows down, the returns on investments may not be enough to repay the interest. Governments may default on the debts and banks will hold many non-performing loans. As a result, most credit booms are followed by debt crises, banking crises or both. For example, the authors noticed that Chile experienced a credit boom from 1971 to 1982 which peaked in 1982; following that, the 1980s' Latin American crisis occurred and crushed the sovereign debt and banking system of Chile.

Blundell-Wignall and Slovik (2011) studied the relationship between sovereign debt crisis and banking crisis in the 2010 European debt crisis. The authors found that banks heavily held sovereign debt of PIIGS countries experienced 30% to 50% haircuts on the sovereign debt assets value. This can negatively impact banks' performance.

Furthermore, Bernanke (1983) also pointed out that sovereign defaults not only increase the credit cost but may also cause many problems such as failure of firms (especially small size firms) and increase the unemployment rate. These, in turn, will increase banks' non-performing loan rate, which potentially leads to a banking crisis.

2.6.3 Debt and Currency Crises

Herz and Tong (2004) analyzed the interrelation between debt and currency crises based on a data set of 74 developing countries from 1975 to 2001 and confirmed the

strong link between the two crises. According to the authors' result, debt and currency crises may be strongly linked together through some common fundamental causes such as the reserve to import ratio, FDI over external debt ratio and GDP growth rate. The authors further explained that a debt crisis or the expectation of a debt crisis negatively impacts the credit market and indirectly increases the interest rates, potentially leading to a currency crisis.

Similarly, Babecky et al. (2012) investigated the origins of currency and banking crises using a quarterly data set of 40 countries from 1970 to 2010 and found a strong link between government debt and currency/banking crises. In particularly, the authors found that the interest rate, government balance, and central bank reserves are important determinants of the risk of currency crises occurring. Further, increasing domestic credit prices and rising interest rates have been found to contribute to banking crises. Countries' debt crises significantly impact the domestic credit market, government balance and interest rate directly; consequently, debt crises can potentially lead to not only banking crises, but also currency crises. As a result, debt and currency crises were named "new twin crises" by Herz and Tong (2004), separate from the twin banking and currency crises in Kaminsky and Reinhart's (1999) study.

Chiodo and Owyang (2002) defined a currency crisis as a shockto a country's currency resulting in a devaluation and possible debt default. The authors believed that the sovereign debt and currency crises are linked together through the devaluation of the country's currency. Once a sovereign debt crisis occurs, foreign creditors will

withdrawal their capital which leads to a decrease in the country's currency exchange rate. On the other hand, currency devaluation significantly increases the cost of repaying external debts that may lead to a default on sovereign debts. According to Wade (1998), the 1997 Asian financial crisis began with the devaluation of the Thai baht in July 1997 and spread to other Asian economies such as Taiwan, Hong Kong, Korea and Philippines and finally became a debt crisis Asian-wide.

Ozkan and Sutherland (1995) investigated the factors that may cause a currency crisis. The authors believed that maturity of debt and the weight of external debt in total sovereign debt have a significant impact on the probability of a currency crisis occurring. According to the authors' study, longer average debt maturity can help to decrease the risk of a currency crisis; meanwhile, countries with higher external debt weight (external debt over total debt) may easily experience a currency devaluation. This is due to, on the one hand, higher external debt weight which implies governments have to exchange domestic currency for foreign currency to repay debts on maturity; on the other hand, the debt repayment pressure from short debt maturity may require the governments to borrow a large amount of credits in a short period. These create large downward pressure on the domestic currency exchange rate, which potentially leads to a currency devaluation.

2.7 Debt Crisis in China?

In the Asian area, the 1997 Asian financial crisis significantly impacted the economy of Asian countries and the sovereign debt issue played an important role in the crisis.

At present, China is in a situation of a high debt burden, lower economic growth, and lower exports. Considering the large GDP amount and its important role in international trade, China's debt problem can significantly impact the global economy. Whether China is the leader of the next regional or global debt crisis depends on how China's government learns the lessons from the previous crises.

2.7.1 The Asian experience of the debt problem

Capital liberalization adopted by Asian countries allowed capital inflow and outflow freedom over the 1990s, bringing large foreign credit inflows which pumped up the economy of Asian countries such as Thailand and South Korea (Wade, 1998). However, this economic boom was associated with a heavy foreign debt burden due to the massive credit inflows. For example, the foreign debt to GDP ratio increased 105.9% and 52.6% from 1990 to 1996 in South Korea and Thailand, respectively. According to Ozkan and Sutherland (1995), large foreign debts may create large pressure on the domestic currency exchange rate due to the requirement of large amounts of foreign currency to repay foreign debts. As a result, the Thai baht was devalued in July 1997 and started the 1997 Asian financial crisis. During the crisis, the Thai baht, and the Korean won had devalued nearly 50% against the U.S. dollar (Wade, 1998). Corsetti, Pesenti and Roubini (1999) noticed that the imbalances in foreign debt accumulation and management, in other words, a heavy foreign debt burden, and average short maturity length played an important role in the 1997 Asian financial crisis.

2.7.2 China's sovereign issues

The recent European sovereign debt crisis in 2009 sent a signal to the Chinese government and policymakers that they needed to pay more attention to the country's debt risk. The news media reported a heavy sovereign debt burden and an increasing sovereign debt risk in China. For example, Dyer (2008) reported a 4000 billion RMB fiscal stimulus package had been made by the Chinese government in 2008 in order to avoid a potential economic recession during the 2008 global financial crisis. However, according to Li (2013), this massive stimulus package created a large sovereign debts burden in China. Besides, the economic growth of China depends heavily on exports; China's export to GDP ratio was about 40% in 2007. Consequently, the decrease in exports due to the 2008 financial crisis generated a downward pressure on economic growth in China (PricewaterhouseCoopers, 2008). The decrease in both exports (-16% in 2009) and GDP (-5% in GDP growth from 2007 to 2009), along with a heavy sovereign debt burden (total debt to GDP ratio reached as high as 282% in 2015) generated by the massive stimulus package, created a significant sovereign debt risk in China (Hinds, 2013). However, study on China's sovereign debt risk is limited (see Hou et al., 2012; Fan & Lv, 2012 and Li, 2012).

Hou et al. (2012) analyzed China's economic stimulus policies since the global financial crisis in 2008 and claimed that China's government faced serious challenges from the global financial crisis. For example, as a result of the European debt crisis the euro currency depreciated over 10%, which significantly impacted exports that use

the euro as the settlement currency. Consequently, the authors noticed that the depreciation of the euro currency may bring foreign exchange losses to China's exports when the export companies exchange the euro currency back to Chinese RMB. Second, because of the economic stimulus plan, especially the 4 trillion RMB stimulus package, the GDP growth rate of China successfully remained steadily; however, the economic growth of China was mainly from exports (before the 2008 global financial crisis) and government investments (after the crisis). This long-term imbalance between investments and consumption suggest an unhealthy economic condition exists in China (Hou et al., 2012).

The 2008 global financial crisis negatively impacted the global economy; as a result, international trade experienced a dramatic decrease including China's exports. Historically, exports play an important role in China's economy. As a result, in order to maintain China's GDP growth, China's central government decided to adopt a RMB4 trillion stimulus program. However, the central government paid no more than 30% of the total RMB4 trillion stimulus package (which is about RMB1.18 trillion) and left the rest of the payment (RMB2.82 trillion) to the local governments (Fan & Lv, 2012). According to Fan and Lv (2012), in order to meet the requirements of this stimulus plan, Chinese local governments had to pay about RMB2.82 trillion (70% of the stimulus package) which far exceeded the tax reserve of local governments. This meant Chinese local governments would not be able to implement the stimulus plan unless they could borrow from the market which was impossible under the monetary policy of China before 2011 (the policy banned local governments from issuing loans

in the open market before 2011). As a result, China came up with a new monetary policy in 2011, which allowed local governments to issue loans and bonds in order to raise money in the open market(Chinese Financial Department document number, 2011 [52]).

Under the Tax Sharing System, local governments in China took 40 percent of the national government revenues. However, since the 2008 global financial crisis, more than 60 percent of China's government expenditure has come from local governments (Fan & Lv, 2012). Consequently, China's local government public debt has increased significantly in recent years. For example, the total amount of Chinese local governments' debt was RMB1.7 trillion in the first half of 2008, however, this amount rose to RMB10.7 trillion at the end of 2010 (Li, 2012). This significant increase in the local government debts pushes up the debt burden and loan repayment pressure of the Chinese government. Consequently, the dramatic sovereign debt surge may lead to a potential sovereign debt problem in China.

In 2006, the Chinese government brought out a new Land Remising law to manage the land-remising fee. Under the policy, "the revenues and expenditures of public land-remising are supposed to be in the local governments' special budgets" (Chinese Government document number, 2006 [31]). Following this, land-remising fees became one of the most important sources of Chinese local government revenue, particularly to finance local government public debt and expenditure of the stimulus package (Fan &Lv, 2012).

Hou (2009) studied the house price dynamics in Beijing and Shanghai and founds significant speculation behavior in the Chinese housing market, which can potentially create a real estate bubble and endanger the Chinese economy. Similarly, Wu, Gyourko, and Deng (2012) reported an extremely high house price to income ratio and confirmed that a housing bubble was occurring in China. Chen, Gan, Hu and Cohen (2013) investigated the Chinese housing market and confirmed a housing bubble in the housing market. The authors also successfully captured land prices as an important determinant of house supply cost which has a strong relationship with house prices in China. Thus, if China's housing bubble bursts, it will significantly impact house prices and house demands. Further, the decrease in the housing market will be transferred to the land market. Once the housing bubble bursts, the housing demand will decrease, which decreases the housing development. The demand for land will be negatively impacted which then causes a decrease in the land prices. Similarly, Fan and Lv (2012) argued that the land-remising fee is one of the key components of local government revenue (for example the land-remising fee occupied about 35% of China's local government revenue in 2013and 30% of that in 2014); as a result, a decrease in land prices and land demands will dramatically decrease the local government revenue. Further, decrease in the local government revenues negatively affects the repayment ability of Chinese local government. Therefore, a sudden shock in China's housing market may result in decreasing debt affordability (ability to repay debt) of the Chinese local government. This can potentially lead to a local government debt crisis in China.

Similarly, John (2011) argued that because of the massive stimulation package implemented by the Chinese government, bank lending increased by 100 percent in 2009. This may generate a potential debt issue as Reinhart and Rogoff (2010) suggest that public debt increased significantly during a short period which could be a sign of a debt crisis approaching. In addition, in order to avoid the potential risk of a housing bubble crisis, restrictions and policies have been implemented by the Chinese government to reduce house prices (restrictions and policies that include increasing down payments for housing loans when households buy a second house; taxes for price increases when selling houses if the house is not held for more than 5 years). These restrictions and policies help to decrease the housing demand by reducing the speculation activities in the housing market and reduced the market house prices. The drop in house prices will negatively impact the bank's collateral value on housing loans (John, 2011). The collateral damage is not only in commercial housing loans, but also in industrial loans using housing materials, such as polymer, polyethylene (PE), polyvinyl chloride (PVC) and acrylonitrile butadiene styrene (ABS) as collaterals. In the worst scenario, John (2011) claimed that as much as 30 percent of China's loans (2.5 trillion U.S. dollars) would be negatively impacted and potentially turned to non-performing loans.

2.8Conclusion

In this chapter, we have discussed the literature on the sovereign debt crisis in Latin American countries (including Argentina, Mexico, Peru, and Brazil), and European

countries (such as Greece, Ireland, Spain, Portugal and Ireland).In the 1980s, Mexico defaulted on its sovereign debt and this sovereign debt problem was transferred to other Latin American countries (such as Argentina and Brazil) in a short period, which started the “lost decade” of Latin America. Nevertheless, history tends to repeat itself and serious debt problems occurred again in the European countries (PIIGS countries) and slowed down the economic growth of the Eurozone and devalued the euro. This chapter also discussed the possible negative impacts of the sovereign debt crisis on countries’ overall economy: a sovereign debt crisis may lead to other crises such as a liquidity crisis, a bank crisis, and a currency crisis. Finally, this chapter discusses the Asian experience on the debt issue and provided an overview of China’s current sovereign debt problem.

Chapter Three

Methodology and Data

3.1 Introduction

This chapter presents the research method and data used in the current study. Section 3.2 shows the variables and their data source and period. Models that are used to answer the objectives of this study are discussed in Section 3.3. Section 3.4 concludes the chapter.

3.2 Variables and Data

There are three generations of models that have been developed to explain financial crises (Fioramanti, 2008). The first generation models discuss the impact of exchange rates on currency, while the second generation models introduce speculation activities. In the first generation models, financial crises are caused by poor economic policies which cannot meet the purpose of a fixed exchange rate and lead to continuous losses in foreign reserves. When foreign reserves fall below a critical level, countries have to abandon the pegged exchange rate. As a consequence, a devaluation of the domestic currency may occur, which in turn starts a financial crisis. However, the model does not discuss the impact of speculations on foreign exchange rates. Therefore, the second generation models introduce speculations (such as self-fulfilling speculative attacks) into the model to explain the financial crisis. The second generation models, focusing on both governments and financial markets, describe the interactions between market participants' and central bank's decisions based on foreign exchange

rates (Blot, Ducoudre & Timbeau, 2016). Both models focus on currency crises. In order to investigate and explain the Latin American crises in the 1980s and the 1990s Asian crises, the third generation model was developed to explain a wider variety of crises such as bank crises and sovereign debt crises. The third generation models focus on the imbalance between financial factors, such as the moral hazard whereby the implicit government guarantee generates the "too big to fail" philosophy. Further, the lack of regulation in financial systems leads to over lending and/or over investment whereby external shocks can significantly decrease capital inflows (Fioramanti, 2008). For example, the over lending of investment banks and other financial institutions on sub-prime housing loans in the U.S., which due to the lack of regulation of sub-prime loan securities, led to the 2008 global financial crisis. Another example is the self-fulfilling model, whereby governments and banks have a large proportion of short-term maturity debts over total debts which potentially can lead to a liquidity run (Cole and Kehoe, 1996). Cole and Kehoe's (1996) study shows that when the average debt maturity period is short (less than one year), debt crises can occur even under a low debt to GDP ratio (any level above 10%).

Early studies on debt issues (such as Krueger, 1987; Euromoney, 1992; Kaminsky & Pereira, 1996) focused on the total amount of government external debts, foreign debts to GDP ratio and external debts to export ratio. For example, Krueger (1987) investigated the debt issue in 19 emerging countries, and found that debt growth plays an important role in determining debt crises. The author discusses how the gross debt built-up increases the government burden and also how the external debts to export

ratio decreases the ability of governments to repay loans. Overall, the debt level has a strong link to debt crises. The higher the debt level, the more risk the country has of falling into a debt crisis. In the recent studies (for example: Boonman et al., 2013; Reinhart & Rogoff, 2010), the positive impact of the debt burden on sovereign risk is still a big concern. Reinhart and Rogoff (2010) tested the origin of debt crises based on a data set from over 70 countries globally and found that the increase in the debt burden can easily lead to a sovereign problem. In addition, Boonman et al. (2013) confirmed that the external debts to GDP ratio is one of the important determinants of sovereign crises based on a long-run study in Argentina from 1870 to 2012.

Table 3.1 Debt Burden and Sovereign Risk

Present value of debt as a percentage of			
Risk level	Exports	GDP	Revenue
Low	100	30	200
Medium	150	40	250
High	200	50	300

Source: World Bank and IMF, 2008

Researchers confronted new challenges in understanding sovereign debt problems when Mexico fell into a debt crisis during the period 1994-1995. Based on previous studies, debt crises can be explained by the debt burden. For example, the World Bank (see Table 3.1) pointed out that if the central government debt to GDP ratio exceeds 50%, it may suggest a higher risk of one country falling into a debt problem. However, Mexico's central government debts were just above 20% of the total GDP during the pre-crisis period, so the central government debt burden cannot explain the Mexico debt crisis in 1994.

In order to explain why debt crises can potentially occur in a low debt burden country, researchers came up with a self-fulfilling model that not only captured the debt level but also introduced debt maturity as a determinant of debt crises. For example, Cole and Kehoe (1996) used a self-fulfilling model to study the Mexico debt crisis from 1994 to 1995 and found significant impacts of external debts' maturity length on sovereign debt crises. The authors explained that sovereign debt may fall into a position where the government can repay old loans if it can sell new debts; the government will default on sovereign debts if it cannot sell new debts. Cole and Kehoe (1996) named this sovereign debt interval as the crisis zone. The authors further explained that the sovereign debt crises risk is extremely high for a country under the crisis zone. Arteta and Hale (2008) believe that governments tend to serve existing debts until it is no longer possible, which may push up sovereign debts into the crisis zone. When the maturity of sovereign debts is short it means that the government has to raise a certain amount of funds in a shorter period to meet the required debt repayment, which is more difficult than in the longer period. As a result, Cole and Kehoe (1996) emphasized that the average length of government debts maturity essentially determines the size of the crisis zone, which significantly impacts sovereign debt risk.

Similarly, Eichengreen and Mody (1999) introduced debt to GDP ratio, debt to export ratio, export growth and sovereign debt maturity length to investigate the debt sustainability. The authors confirmed that the average length of debt maturity has a

strong link with sovereign debt condition, which supported Cole and Kehoe's (1996) findings. Based on Cole and Kehoe's (1996) findings, a short average debt maturity length (shorter than one year) requires large amount of foreign reserves to repay debts in a short period compared to a longer debt maturity length. This significantly increases the demand for foreign currency, which may lead to a decrease in foreign exchange rates. The decrease in foreign exchange rates further increases the cost to repay external loans, thus governments may potentially decide to default on sovereign debts when the cost of sovereign debt repayments is too high.

Recently, Desgranges and Rochon (2014) noticed that the sovereign debt burden and the sovereign debt maturity structure play important roles in controlling sovereign risks. The authors believe that a longer maturity length can help to hedge the risk of economic fundamentals' uncertainty, which can decrease sovereign risks. Similarly, Niepelt (2014) confirmed that the sovereign debts' maturity structure significantly impacts sovereign risks. The balance between long term and short term debts is important in controlling sovereign debt risks.

In spite of the debt quality (debt-GDP ratio, debt-revenue ratio, sovereign debt maturity etc.), some other factors also significantly impact the sovereign debt condition. For example, Yue (2010) adopted external debt to GDP ratio, debt service to GDP ratio and interest rate to study sovereign defaults and debt renegotiations for emerging economies including Argentina. The author pointed out that the increase in interest rates raises the cost for governments to borrow new debts; consequently,

sovereign defaults might occur due to the extremely high credit price. Furthermore, the borrowing costs' growth also affects companies and industries that need to raise money in the open market, which may directly impact government tax revenues and further decrease the debt affordability of the government. On the other hand, once the potential sovereign default or restructuring expectation exists, the credit supply will be directly impacted, which may lead to an increase in interest rates (Yue, 2010).

Similarly, Holland, Kirby and Orazgani (2011) tested sovereign risks by studying the Eurozone countries' interest liability burden. The authors found that sovereign defaults easily occur with large imbalances between governments' debt burdens and revenues. Interest rate is one of the significant determinants of a sovereign debt burden (Holland, Kirby & Orazgani, 2011) and also impacts tax revenues dramatically (Yue, 2010). As a result, Holland et al., (2011) believe that interest rate is one of the important variables in testing sovereign debt risks. These findings also supported Yue's (2010) study.

According to Cantor and Packer (1996), income, economic growth and inflation also largely impact sovereign debt sustainability. According to the authors' explanation, income determines the ability of a government to repay debts: a relatively higher economic growth rate suggests that the government can serve the debt burden more easily over time. In addition, inflation plays an important role in controlling sovereign risks. Thornton and Vasilakis (2016) found a lower inflation and a lower inflation uncertainty have a positive impact on sovereign risks based on 64 countries globally

from 1985 to 2012.

Similarly, Fuertes and Kalotychou (2007) investigated sovereign debt risks based on a dataset of 75 emerging countries for the period from 1984 to 2000. The authors identified that variables such as government revenues, GDP growth, inflation, interest rate, average debt maturity and total debt to GDP ratio causally determine sovereign debt instabilities.

Our study aims to investigate the sovereign debt risk in China. However, sovereign debt risk in a country cannot be observed directly; thus, estimators are needed to measure sovereign debt risk. According to Maltritz, Buhn and Eichler (2012) and Balima, Combes and Minea (2017), two indicators are widely used to estimate sovereign debt risk in the literature: yield spreads and sovereign ratings. Yield spreads are not suitable to investigate sovereign debt risk in China (details of reasons and results are provided in Appendix D); we use sovereign ratings alone to estimate Chinese sovereign debt risk in the current study.

Manasse, Roubini and Schimmelpfennig (2003) tested sovereign debt risks in 47 countries during the period from 1970 to 2002 and established an early warning system for sovereign debt crises. According to the authors, the Standard & Poor's sovereign rating is widely used to measure sovereign debt risk (also see Fuertes & Kalotychou, 2007 and Fioramanti, 2008). Manasse et al. (2003) used a logistic model to test financial fundamentals' impacts on the occurrence probability of a sovereign debt crisis. Based on the authors' study, the logistic model can be treated as an early

warning system for countries' debt risks; a probability larger than 0.5 is a clear signal that a sovereign debt problem is imminent.

This current study tests sovereign debt risk in China (Standard & Poor's sovereign rating) using macroeconomic fundamentals such as debt-GDP ratio, debt-revenue ratio, debt interest rate and inflation. Data are obtained from the World Bank (economic growth rate, exchange rate of Chinese RMB to the U.S. dollar and the U.S. treasure bond yield), the National Bureau of Statistics of China (inflation rate, interest rate, government bond yield, domestic government debt, foreign government debt, government revenue and government expenditure), Standard and Poor's (S&P sovereign ratings) and annual reports of commercial banks in China (earnings per share, non-performing loan rate and capital adequacy ratio).

In this study, we chose Chinese commercial banks only and exclude policy banks of China from our data set. Chinese policy banks are not profit-making-oriented but to fund the policy targets of the Chinese government; thus, the policy banks in China do not operate dependently. In addition, there are three different types of commercial banks in China: state-owned commercial banks; joint-equity commercial banks; and city/village and township banks. Unlike the former two bank types that operate widely at the national level, city/village and township banks operate in small areas, such as a city or a province; thus, city/village and township banks are also excluded from our study.

The state-owned commercial banks are large sized banks; while non-state-owned

banks (joint-equity commercial banks) are small- and mid- sized banks. We select an equal amount of both state-owned commercial banks (Bank of China, China Construction Bank, Industrial and Commercial Bank of China and Agriculture Bank of China) and non-state-owned commercial banks (China CITIC Bank, China Everbright Bank Co., Ltd, China Merchants Bank and Industrial Bank Co., Ltd), to avoid potential bias issue, such as bank type and size. An alternative way to avoid a potential bias from the bank type and size is to select all the commercial banks in the market (17 commercial banks operated nationally in China) while controlling the size (market share) of each bank (see Appendix E).

Based on the data availability, official data of some macroeconomic factors before 1996 are not available and only yearly data are available (such as China's total debts, government revenues and government expenditures). Further, the 2008 financial crisis may have a significant impact on China's sovereign debt risk due to the decrease in exports and dramatic increase in total government debts (China's 4 trillion RMB economic stimulus package in 2008). In addition, the current study also aims to investigate the relationship between sovereign risk and banking risk in China. Many Chinese commercial banks' annual reports are not available before 2006, especially for the joint-equity corporate commercial banks.

Thus, the current study investigates the sovereign debt dynamics and sovereign risk of China based on yearly data from 1996 to 2014 and tests the relationship between sovereign risk and banking risk in China using yearly panel data from 2006 to 2014.

3.3 Models

3.3.1 Debt Dynamics Model

According to Fioramanti (2008), the imbalance of sovereign debts' level and government budget is one of the important determinants of sovereign debt risks. A higher level of sovereign debt requires higher government budget restrictions which can weaken the sovereign debt sustainability. This is because the government needs fiscal surplus to repay sovereign debts and interests. The more debts a government has the more the government needs to repay in the future. This will challenge the government's fiscal surplus and potentially generates a sovereign debt problem.

China's sovereign debts have increased dramatically in recent years. The total debt to GDP ratio in China was 187% at the end of 2012, and reached as high as 282% in 2015. This ratio only numbered 105% in 2000. The significant increase in the debt burden of China may be due partly to the decrease in GDP growth, which decreased from 14.2% to 6.9% during 2007-2015 (the impact of the 2008 global financial crisis). More importantly, the government spending on a 4 trillion RMB economic stimulus package significantly attributed to the sharp increase in the debt burden of China, which may cause serious debt problems in China. As a result, the debt dynamics model in this study is aimed at testing how China's central government debts change and its equilibrium dynamics. A larger gap between sovereign debts and equilibrium sovereign debts in China potentially suggests that a sovereign problem occurs.

In order to estimate the sovereign debt dynamics, Pirtea et al. (2013) introduced an

empirical model (Equation 3.1) based on a government budget constraint equation.

$$SD_t = (E_t - R_t) + (1 + DIR_t) * DD_{t-1} + (1 + FIR_t) * FD_{t-1} * ER_t \dots\dots\dots (3.1)$$

Equation (3.1) captures the variation of sovereign debts at time T, SD_t, which is based on government expenditure during period T, Et, government revenue during period T, R_t, debt interest rates of domestic debts and foreign debts, DIR_t and FIR_t, economic growth during period T, EG_t, the exchange rate of domestic currency to foreign currency (U.S. dollars), ER_t, and sovereign debts at time T-1, domestic debts DD_{t-1} and foreign debts FD_{t-1}.

Economic growth plays an important role in measuring sovereign debts. The debt to GDP ratio captures the debt burden of a country, which strongly impacts the country's sovereign risk. The amount of sovereign debts alone is generally meaningless without the GDP scale due to the large size difference among countries' economies. Adding economic growth into equation (3.1), the sovereign debt dynamics become a function of macroeconomic fundamentals such as government expenditure, government revenue, existing sovereign domestic debts, existing sovereign foreign debts, domestic debt interest rate, foreign debt interest rate and exchange rate. Government expenditure and economic growth increase sovereign debts; while government revenue, debt interest rates (domestic and foreign), existing sovereign debts (domestic and foreign) and exchange rate negatively impact sovereign debts. Thus, this study uses an OLS regression model in equation (3.2) to test the sovereign debt dynamics in China.

$$SD_t = \alpha + \beta_1 DD_{t-1} + \beta_2 FD_{t-1} + \beta_3 R_t + \beta_4 E_t + \beta_5 EXL_t + \beta_6 EG_t + \beta_7 DIR_t + \beta_8 FIR_t + \varepsilon \ldots\ldots (3.2)$$

Table 3.2 presents the definitions of the variables in equations (3.1) and (3.2)

Table 3.2 Variables and Measurements (for equations3.1 and3.2)

	Variables	Measurements
E	Expenditure Growth	Chinese central government expenditures growth rate
R	Revenue Growth	Chinese central government revenues growth rate
SD	Sovereign Debt Growth	Chinese central government total debts growth rate
DD	Domestic Debt Growth	Chinese central government domestic debts growth rate
FD	Foreign DebtGrowth	Chinese central government foreign debts growth rate
ER	Exchange Rate	Yearly exchange Rates of RMB to US dollars
EG	Economic Growth	Chinese yearly GDP growth
EXL	Exchange Losses/Gains on External Debts	The changes of foreign debts interest based on exchange rate changes
DIR	Domestic Interest Rate	Chinese central bank basis one year lending rates
FIR	Foreign Interest Rate	US Loan Prime Rates

In the literature, debt interest rate and government deficit significantly increase the sovereign debt burden (Genberg & Sulstarova, 2008; Tielens, Van Aarle & Van Hove, 2014). Existing sovereign debt levels in previous time periods (outstanding debts that have not been paid back) tend to decrease the sovereign debt borrowing (Pirtea et al., 2013). GDP growth has a positive impact on sovereign debts (Fan & Lv, 2012; Xu & Zhang, 2014). The increase in foreign exchange rates will decrease the interest on foreign debts in the domestic currency, which helps to decrease sovereign foreign debts (Pirtea et al., 2013; Kinoshita, 2006).

Accordingly, the sovereign debt dynamics are determined by the debt interest rate, GDP growth rate, capital gains or losses on foreign debt, government revenue and government expenditure. Therefore, we can estimate the equilibrium sovereign debt

by using the economic fundamentals such as interest rate, GDP growth, foreign exchange, government expenditure and revenue based on equation (3.2).

The sovereign debt dynamics model (Equation 3.2) allows us to capture the equilibrium sovereign debt dynamics based on economic fundamentals (Pirtea et al., 2013). To compare the regression result of equation (3.2) with the real sovereign debt level of China, we can address how much sovereign debt of China deviates from its equilibrium which can measure the sovereign debt risk in China.

3.3.2 Sovereign Risk Model

In order to test sovereign debt risks and predict potential sovereign debt crises in a country, Manasse et al. (2003) used a logistic model (Equation 3.3) to test financial fundamentals' impacts on the risk of a sovereign debt crisis based on a data set of 47 countries during the period from 1970 to 2002. The authors believe that the logistic model can predict countries' debt risks, whereby a probability (calculated based on logistic model results) larger than 0.5 clearly signals that a sovereign debt problem is imminent.

$$P_t = f(SR_{t-1} * X_{t-1}; (1 - SR_{t-1}) * X_{t-1}) \quad (3.3)$$

Equation (3.3) measures sovereign risks at time T, Pt, based on a binary logistic model, which captures the probability (0 to 1) of sovereign risks, Pt. When the estimated Pt falls into 0.5-1, a sovereign debt crisis will occur; otherwise, a sovereign debt crisis will not occur at time T. The sovereign risk model measures sovereign risks based on

the Standard & Poor's indicator at time T-1, SRt-1, and explanatory variables X at time T-1, Xt-1. The explanatory variables X represent the country's economic fundamentals such as sovereign debt to GDP ratio, sovereign debt to revenue ratio, debt rates, GDP growth and inflation index.

The logistic model (Equation 3.3) predicts the probability of sovereign debt crises/defaults based on the Standard & Poor's indicator and macroeconomic variables such as sovereign debt burden, debt affordability, debt interest rates, economic growth and inflation. However, the model (Equation 3.3) can only be used to predict the sovereign crises' occurrence (0 or 1), which does not capture the sovereign risk level and provide a warning to the government when the sovereign risk level is getting larger.

Therefore, based on the binary logistic model (Equation 3.3) this current study uses an ordered logistic model to measure sovereign risk (Equation 3.4). The Standard & Poor's sovereign rating is widely used to measure sovereign risk in the literature (Manasse et al., 2003; Maltritz et al., 2012). Following the literature, this study uses the Standard & Poor's sovereign rating to measure sovereign risk in equation (3.4). Further, by adopting the Standard & Poor's sovereign rating as the sovereign risk measurement, the current study can separate the sovereign debt risk level based on the explanatory variables X into 6 ordered grades which meet the Standard & Poor's sovereign rating: top grade (AAA), high quality grade (AA+, AA, AA-), upper medium quality grade (A+, A, A-), medium quality grade (BBB+, BBB, BBB-),

non-investment grade (from BB+ to C) and default grade (SD and D). Based on equation (3.4), expanding the explanatory variables X, the ordered logistic regression model can be rewritten as the sovereign risk model (Equation 3.5).

$$SR_t = \alpha + e^{\beta X_{t-1}} + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

$$\text{logit}(SR_t) = \alpha + \beta_1 DB_{t-1} + \beta_2 DA_{t-1} + \beta_3 DR_{t-1} + \beta_4 IF_{t-1} + \beta_5 EG_{t-1} + \varepsilon \ldots\ldots (3.5)$$

Table 3.3 presents the definitions of the variables in equations (3.4) to (3.5)

Table 3.3 Variables and Measurements (for equations3.4, 3.5, and 3.6)

	Variables	Measurements
X	Explanatory Variables (X_1, X_2, X_3, X_4, X_5)	
X_1(DB)	Debt Burden	Debt-GDP Ratio of China
X_2(DA)	Debt Affordability	Debt-Revenue Ratio of China
X_3(DR)	Debt Rate	Chinese central bank basis Lending Rate
X_4(IF)	Inflation	China's CPI
X_5(EG)	Economic Growth	China's GDP Growth Index
SR	Sovereign Risk	S&P Sovereign Ratings of China

In the sovereign risk model (Equation 3.5), debt-GDP ratio (World Bank, 2008; Eichengreen & Mody, 1999; Yue, 2010), debt- revenue ratio (Manasse et al., 2003; Holland, Kirby & Orazgani, 2011) and debt rates (Moorad, 2010; Yue, 2010) positively impact the sovereign risk grade (increase sovereign risk); GDP growth (Cantor & Packer, 1996; Pirtea, Nicolescu & Mota, 2013) and CPI (Fuertes & Kalotychou, 2007; Roberts, Kranzler & Williams, 2014) decrease sovereign risk.

The World Bank (2008) suggested the debt-GDP ratio is an important signal of sovereign risk as a central government debt-GDP ratio that is higher than 50% may lead to instability in a country's sovereign risk. Yue (2010) founds that a higher debt

burden level potentially increases credit prices; the government may not afford to borrow in the market to rollover existing sovereign debts, which may lead to a sovereign default.

The continued imbalance between sovereign debts and revenues create an increasingly high debt-revenue ratio of a country, which can easily lead to a sovereign default (Holland, Kirby & Orazgani, 2011). Similarly, Manasse et al. (2003) confirmed the significant impact of debt-revenue ratio on sovereign risk based on an empirical study of 47 countries globally from 1970 to 2002.

Sovereign debts include government loans (floating rates) and government bonds (fixed rates). The change in debt interest rates directly impacts sovereign loans at floating rates, which significantly impacts sovereign risk (Yue, 2010). Indirectly, debt interest rates' changes may impact the sovereign bond value, which has an impact on the country's sovereign risk (Moorad, 2010).

According to Cantor and Packer (1996), a higher economic growth helps the government to serve sovereign debts over time, which in turn decreases sovereign risk (also see Pirtea et al., 2013). This may be due to economic growth potentially increasing government revenues and decreasing the sovereign debt burden.

The change in inflation potentially impacts the value of existing foreign sovereign debts. This is due to inflation, which can influence the domestic currency value; when CPI increases, the domestic currency may devalue (Fuertes and Kalotychou 2007).

The currency devaluation has a negative impact on external debts due to foreign exchange rate losses and a positive impact on domestic debts due to the decrease in real interest rate (interest rate – inflation rate). Thus, CPI may decrease sovereign risk in China (domestic debts dominated over 99.6% of total government debts in 2014).

Based on Manasse et al's (2003) study, the logistic model has the ability to predict the likelihood of sovereign debt problems in China. According to the sovereign risk model (Equation 3.5), the sovereign debt risk at time T can be estimated by macroeconomic fundamentals such as debt-GDP ratio, debt-revenue ratio, debt rates, GDP growth and inflation during time period T-1. Manasse et al. (2003) assumed that the logistic model can serve as an important early warning system for sovereign debt crises. The Standard & Poor's sovereign rating estimates countries' risks and is calculated based on countries' previous macroeconomic fundamentals; as a result, the use of present macroeconomic fundamentals (during the time period T) can somehow predict the Standard & Poor's sovereign rating in the future (at time T+1). Thus, by using the Standard & Poor's sovereign rating in measuring sovereign risk, the sovereign risk model can serve as an early warning system model in China.

Our study will investigate sovereign debt risk in China using the sovereign risk model (Equation 3.5). This model not only tests how macroeconomic fundamentals impact sovereign debt risk, but also predicts the possibility of a potential sovereign debt crisis occurring in China.

3.3.3 Bank Risk Model

Buch, Koetter and Ohls (2013) studied the linkage between bank risk and sovereign debt risk based on a quarterly data set of 1898 German banks during the period from 2004 to 2010. The authors found that before the crisis period, investments in sovereign bonds tend to decrease bank risk; however, holding large amounts of sovereign bonds significantly increases bank risk after a sovereign crisis occurs in such countries. As a result, the authors concluded that government bond risks are strongly linked to aggregate bank risks.

Similarly, Gennaioli et al., (2014) confirmed the significant impact of sovereign risk on banks, based on 191 countries' data from 1998 to 2012. The authors argued that the factors which impact bank risk include the bank characteristics such as bank performance, bank ownership and capital adequacy; and country economic environmental factors such as economic growth, inflation and sovereign risk.

This current study aims to investigate the impact of sovereign risk on the financial system particularly banks. Equation (3.6) is the bank risk model in this study which tests the impact of sovereign risk and other macroeconomic fundamentals, such as economic growth, inflation, debt rates, capital adequacy ratio, earnings per share, non-performing loan rate and state ownership on the banking risk in China.

$$Z_t = \alpha + \beta_1 EG_t + \beta_2 SR_t + \beta_3 IF_t + \beta_4 GDY_t + \beta_5 PS_t + \beta_6 DL_t + \beta_7 CAR_t + \beta_8 BO + \beta_8 Year + \varepsilon \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . (3.6)$$

Table 3.4 presents the definitions of the variables in equation (3.6)

Table 3.4 Variables and Measurements (for equation 3.6)

	Variables	Measurements
Z	Banking Risk	Z-score (calculated by equation 2 below)
SR	Sovereign Risk	S&P sovereign rating of China
IF	Inflation	CPI of China
EG	Economic Growth	GDP Growth of China
GDY	Government Debt Yield	Domestic Debt Yield of banks
CAR	Capital Adequacy Ratio	Capital Adequacy Ratio of banks
PS	Earnings per Share	Yearly profit per share of banks
DL	Non-performing Loan Rate	Non-performing loan rate of banks
Year	Year effect of data set period (2006-2014) captured by ordered categories (1-9) referring to year (2006-2014), respectively	
BO	Dummy variable (bank ownership) captures whether the bank is owned by government (0 or 1)	

The dependent variable Z_t in equation (3.6) is the Z-score, which is widely used to capture bank risks such as bank performance, profitability and volatility (Buch et al., 2013; Beck, Laeven, Levine & Pennacchi, 2008; Laeyen & Levine, 2009). The Z-Score is calculated based on some fundamentals such as capital-asset ratio, ROA, return on assets, E/A, and standard deviation of assets return, σ_{ROA}, shown in equation (3.7).

$$Z = \frac{(E/A + ROA)}{\sigma_{ROA}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

Based on equation (3.6), our study will estimate how macroeconomic fundamentals such as economic growth, inflation, sovereign risk, debt rates and bank characteristics including capital adequacy ratio, profit per share, dead loan rate and state ownership

impact on bank risk (Z-Score). More importantly, Z-score (Equation 3.7) is calculated by the capital-asset ratio return on assets and the standard deviation of assets return. A higher Z-score suggests lower bank risks.

In the literature, economic growth significantly decreases bank risks (Levine, 1998). During an economic boom period, credit demands will increase, which in turn leads creditors (including banks) to have more optional choices to implement strict credit rationing. This can decrease the credit risk of banks.

According to Gennaioli et al. (2014), sovereign risk significantly impacts the return on government debt through two channels. The first is the saleable government bond, where a sovereign debt problem decreases the government bonds' market price. Second, the sovereign debt issue may lead to debt default, restructure or rollover which can impact the return on unsaleable government debts. Thus, sovereign risk can significantly affect bank risk (Z-Score) based on equation (3.7), through its impact on government debt returns (one of the combinations of the return on assets of banks).

Demirguc-Kunt and Huizinga (2010) noticed that inflation increases the fee-income share (the ratio of non-interest income over total operating income) and the non-deposit fund share (the ratio of non-deposit funds over total deposits and short-term funds), which will decrease bank stability and increase bank risk.

Sovereign debt rates positively impact the Z-score. Higher debt rates increase the return on government debts held by banks, which increases the profitability of banks;

this helps to reduce bank risk (Kohler, 2012).

Profit per share captures bank profitability and the capital adequacy ratio measures bank stability; these two variables positively impact bank performance, which decrease bank risk (Kohler, 2012; Mergaerts & Vennet, 2016). The increase in dead loan rate (non-performing loan rate) significantly decreases bank performance and bank efficiency, which increase bank risk (Li et al., 2009).

Bank ownership plays an important role in testing bank risk. Bonin, Hasan and Wachtel (2005) found that government-owned banks have a relatively higher return on equity than joint-equity corporate banks. This suggests the positive impact of bank ownership on bank profitability, which helps to reduce bank risk.

3.4 Conclusion

Chapter Three discussed the data and methodology used in this current study. The chapter discussed three models used to capture the three objectives of the study. This study used the debt dynamic model (Equation 3.2) to address how much the sovereign debt of China deviates from its equilibrium; employs the sovereign risk model (Equation 3.5) to test the impact of economic fundamentals on sovereign risk of China; and introduces the bank risk model (Equation 3.6) to estimate the effects of sovereign risk on bank risk in China. The chapter also discussed the data, time period and variables used in the models. The results of the models will be presented in the following chapter.

Chapter 4

Results

4.1 Introduction

This chapter presents the results and findings of the present study. Section 4.2 provides the regression results of the debt dynamics model. The results for the sovereign risk model are presented in Section 4.3. Section 4.4 provides the results and findings of the bank risk model and Section 4.5 summarises the findings of the empirical analyses.

4.2 Results of the Debt Dynamics Model

The debt dynamics model (equation 3.2) captures the relationship between sovereign debt dynamics and economic fundamentals in China. The economic fundamentals include domestic debt growth, foreign debt growth, government expenditure, government revenue, economic growth, domestic debt interest rate, foreign debt interest rate and foreign exchange losses/gains. This model is a linear model and is estimated by the least squares method. The estimated results of the debt dynamics model are presented in Table 4.1. The coefficients and significances of each variable will be discussed in this section.

Table 4.1 Determinants of Sovereign Debt Dynamics of China

Variable	Coefficient Estimates
Domestic Debt Growth(t-1)	-0.433**
	(-2.845)
Foreign Debt Growth(t-1)	0.582
	(0.797)
Government Expenditure	6.218***
	(3.640)
Government Revenue	0.504
	(0.273)
Economic Growth	2.030**
	(2.270)
Domestic Debt Interest Rate	-16.020**
	(-2.369)
Foreign Debt Interest Rate	-0.082
	(-0.166)
Foreign Exchange Losses	-3.43E-05
	(-1.432)
Number of observations	19
R-squared	0.700
F-statistic (p-value)	0.086*
Durbin-Watson test	2.206

Notes: t-statistics in parentheses below the estimates. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. F-statistic presents the joint significance of the coefficients of the explanatory variables.
Source: Author's calculations.

4.2.1 Sovereign Debt Condition

The debt dynamics model tests how the sovereign debt condition in the last period ((t-1) represents the last term in the debt dynamics model) impacts on the sovereign debt in the current term. Specifically, the debt dynamics model (equation 3.2) investigates the impact of existing government debts on the sovereign debt in China for the current year based on the yearly data.

The sovereign debt condition of the last term is separated into two parts: domestic debt growth and foreign debt growth. The domestic debt growth (t-1) is statistically significant at the 5% level and has a negative (-0.433) effect on sovereign debts (see Table 4.1). This suggests that if the domestic debt growth (t-1) increases by 1%, it will decrease sovereign debt growth by 0.433%. Pirtea et al. (2013) argued that a higher existing sovereign debt level may generate a higher sovereign risk, which decreases the new government bond issues.

Table 4.2 Sovereign Debt Statistics of China 1995-2014

Year	Total debt (trillion)	Domestic debt (trillion)	Domestic debt/Total debt
1995	0.69	0.68	98.87%
1996	0.76	0.75	98.83%
1997	0.92	0.91	98.95%
1998	0.96	0.95	98.87%
1999	1.79	1.78	99.32%
2000	2.35	2.33	99.46%
2001	3.02	3.01	99.60%
2002	3.56	3.54	99.60%
2003	4.18	4.16	99.66%
2004	4.67	4.65	99.66%
2005	5.01	4.99	99.57%
2006	5.37	5.35	99.56%
2007	5.65	5.62	99.54%
2008	7.49	7.46	99.64%
2009	7.12	7.09	99.63%
2010	8.19	8.17	99.65%
2011	16.98	16.95	99.79%
2012	15.67	15.63	99.72%
2013	15.29	15.24	99.70%
2014	14.26	14.20	99.63%

Source: National Bureau of Statistics of China

As one of the important measurements of a country's debt condition, domestic debt can capture the debt burden of the country. For example, the domestic debt of China occupies more than 98% of the total sovereign debt (see Table 4.2). The large proportion of domestic debts over total debts (approximately 99%) enables the Chinese government to make decisions about issuing new debts entirely based on the existing domestic debt condition. Pirtea et al. (2013) suggest that the existing debt level significantly impacts the debt dynamics in a country; thus, the Chinese government may decrease or even stop borrowing when the domestic debt growth (t-1) is extremely high. This contributes to the negative impact of the domestic debt growth

(t-1) on the sovereign debt growth in China (see Table 4.1).

The result shows the impact of foreign debt growth on sovereign debt growth in China is not significant because the domestic debt dominates the sovereign debt in China (the ratio of domestic debts over total sovereign debts in China was over 98% during 1995-2014). This means the foreign debt condition has an extremely low impact on the total debt. Further, China's foreign reserves at the end of 2014 were as high as USD3,843 billion which equals RMB23,519 billion. Based on the data in Table 4.2, the foreign debt of China at the end of 2014 was RMB5,300 billion which was approximately 22% of China's foreign reserves. This suggests that the Chinese government may ignore the impact of foreign debt condition when making decisions about issuing new sovereign debts since it is relatively easy to use foreign reserves to repay foreign debts. Similarly, Rodrik's (2007) study claims that, based on the IMF study, holding a certain amount of foreign reserves helps to reduce the risk of foreign debts, especially for developing countries. Rodrik believes the level of foreign reserves that the country needs to hold significantly depends on the external debt size. This may explain the insignificant impact of the foreign debt (-1) on sovereign debts in China.

Pirtea et al. (2013) investigated the sovereign debt dynamics of Romania from 2000 to 2011 and confirmed that lagged public debt condition significantly impacted the sovereign debt dynamics in Romania. The authors found that temporary expectations significantly impact sovereign debt changes, especially after a financial crisis breaks

out (such as the 2008 global financial crisis). This finding supports the results of the debt dynamics model (equation 3.2) that the massive government debt of China (mainly caused by the economic stimulus program in 2008) creates negative expectations which cause the Chinese government to decrease borrowing in the open market to avoid an increase in sovereign debt risk.

4.2.2 Government Budget Conditions

The debt dynamics model (equation 3.2) also discusses how government budget conditions impact on sovereign debt dynamics in China. The government budget is based on two fundamentals: government expenditure and government revenue.

The government expenditure is significant at the 1% level and positively (6.218) impacts the sovereign debt in China, while the coefficient of the government revenue is insignificant in the debt dynamics model. This implies that if we only consider the impact of the government budget, China's sovereign debt dynamics are mainly affected by government spending. If the Chinese government expenditure increases by 1%, the sovereign debt will increase by 6.218%.

According to Pirtea et al. (2013), government expenditures have a significant impact on the fluctuation of sovereign debts. The evidence can be found in China's massive economic stimulus package, which was implemented in 2008. The Chinese government spent 4 trillion RMB on several infrastructure projects, such as public transport (particularly the high-speed railway), real estate and the 2008 Wenchuan

earthquake recovery. As a result, the sovereign debt (especially local government debt) increased dramatically (Fan & Lv, 2012).

Pirtea et al.'s study (2013) is supported by an earlier study (Fioramanti, 2008). Fioramanti (2008) investigated the sovereign debt changes in 46 emerging countries from 1980 to 2004 and found a strong relationship between government expenditures and sovereign debt dynamics. The rise in the government spending increases the government deficit, which may require the government to borrow more credit in the open market to balance the government budget in the long run.

Theoretically, the increase in government revenues increases the sovereign debt affordability and has a positive impact on sovereign debt dynamics. However, in the debt dynamics model (equation 3.2) the positive coefficient is not statistically significant. The insignificant impact of government revenues on sovereign debt dynamics in China could be attributed to the high economic growth in the long run (averaging over 10% per year since the 1980s) that creates positive expectations on future government revenues. Further, in China's tax system, the land-remising fee, one of the main financial sources of the Chinese government, is not included in the government revenue calculation. Chinese governments, especially local governments, use the land-remising fee as collaterals when borrowing credits from banks. For example, Wu and Feng (2014) observed that over 40% of the local government loans in China were guaranteed by the land-remising fee. As a result, government revenues may somehow not significantly impact the sovereign debt dynamics in China.

4.2.3 Economic Growth

Economic growth has a positive impact on sovereign debt dynamics in the debt dynamics model and is significant at the 5% level. Economic growth is an important determinant of the sovereign debt risk. The weight of sovereign debts over GDP is widely used to capture the country's debt burden (see Section 3.2). To avoid a potential sovereign crisis, the government may keep the debt burden under a critical level (50% as suggested by the IMF and the World Bank). A higher GDP allows the government to borrow more from the credit market without having to increase the debt burden. Therefore, economic growth has a positive impact on sovereign debt dynamics.

Our finding is supported by Fan and Lv (2012). The authors tested the public debt, the fiscal prudence and the growth sustainability in China, and reported that an increase in sovereign debts in China is closely related to high economic growth. On the other hand, the growth in sovereign debts also creates a higher employment rate and opportunities in the heavy industry (benefits by government investments in the real estate market and high-speed train projects) that further increase the GDP of China. Similarly, Xu and Zhang (2014) investigated China's sovereign debt risks from 2000 to 2012. The authors argued that high economic growth has a significant impact on the sovereign debts of China since the economic growth helps to repay sovereign debts.

4.2.4 Interest of Debts

The interest of sovereign debts including domestic debts interest and foreign debts interest depends on three fundamentals: domestic debt interest rates, foreign debt interest rates and foreign exchange losses/gains based on exchange rate dynamics.

Domestic debt interest rate significantly and negatively impacts (at the 5% significance level) sovereign debt dynamics (see Table 4.1). This suggests that when the domestic debt rate increases by 1%, the sovereign debt will decrease by 16.02%. The negative relationship between domestic debt rates and sovereign debt dynamics is due to the increase in credit costs. Interest rate determines credit costs for borrowers. Moreover, credit costs strongly impact the borrowers' decision on raising money in the credit market. The increase in domestic debt rates raises the credit cost of borrowing domestically, and this increases the credit price, which in turn decreases the new sovereign debt issuance. Further, for some existing sovereign debts that have a floating rate, the increase in interest rates will also increase the debt cost of existing debts. Similarly, Paesani, Strauch, and Kremer (2006) found that the country's total debt is significantly impacted by interest rates in the long run based on the data from Germany, Italy, and the U.S.

Foreign debt rates and exchange losses show an insignificant impact on sovereign debt dynamics in the model. The extremely small foreign debt amount and the large number of foreign exchange reserves in China contribute to the insignificant coefficients. Based on the data from the National Bureau of Statistics of China (see Table

4.2), the foreign debt occupies less than 2% of China's total sovereign debts. Further, China's foreign exchange reserves numbered over USD3800 billion by the end of 2014. This may cause the sovereign debt dynamics in China to be insensitive to changes in foreign debt rates and exchange rates. Similarly, Johnston (2016) noticed that the sovereign debt risk in China heavily depended on domestic debts and domestic debt rates due to the low external debt level (0.37% of total government debts at the end of 2014).

Kinoshita (2006) tested the relationship between interest rates and government debts using a data set of 19 OECD countries from 1971 to 2004. The author found a strong relationship between interest rates and sovereign debts. Further, Pirtea et al. (2013) confirmed the strong impact of interest rates on sovereign debt dynamics and believed that reducing the interest rate risk is one of the critical factors to manage the public debt. Further, the authors also pointed out that the government may target to increase the domestic debt weight of sovereign debts in order to limit the currency risk of the sovereign debt portfolio, which may support the insignificant impacts of foreign debt rates and exchange losses on sovereign debts in the debt dynamics model.

4.2.5 Durbin-Watson Test

The Durbin-Watson (D-W) statistic tests for the first-order autocorrelation in the error term in a model. The D-W statistic ranges between 0 and 4; a model does not suffer from autocorrelation when the D-W statistic is close to 2. This study used the time series data in the debt dynamics model; therefore, it is important to test the

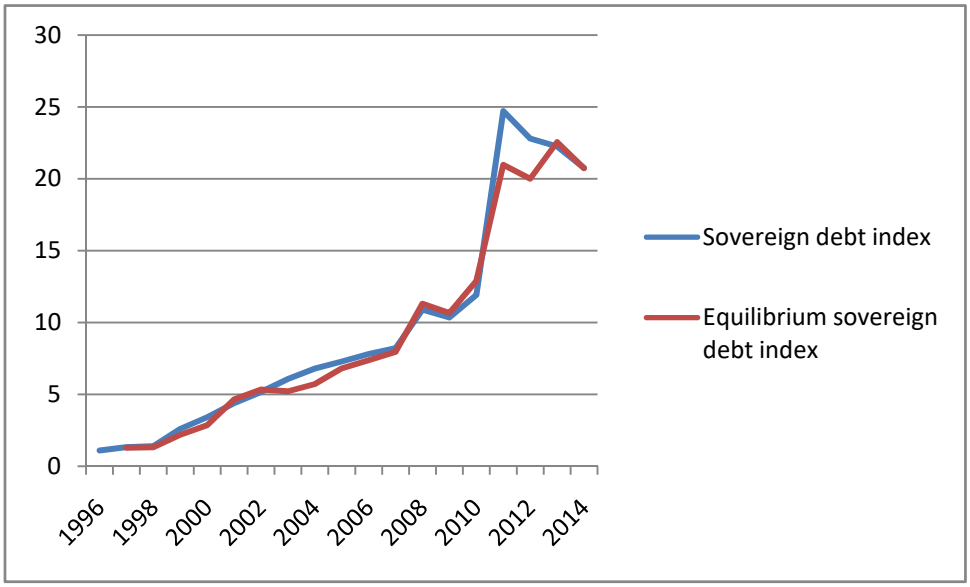
autocorrelation. According to Ostrom (1978), the non-autocorrelation is one of the assumptions of the ordinary least squares (OLS) regression and the time series data routinely lead to a violation of such assumption. In addition, autocorrelation occurs in the time-series data when a model is mis-specified which means that some independent variables can explain the dependent variable, but are not included in the model (Ostrom, 1978).

The results in the debt dynamics model (see Table 4.1) show the Durbin-Watson value is 2.206 and the critical value of the D-W statistics (dU) is 2.668. The D-W value (2.206) is between 4-dU (1.332) and dU (2.668), which suggests the debt dynamics model does not suffer from autocorrelation issues. The result of the D-W test shows our debt dynamics model is not mis-specified.

4.2.6 Debt Dynamics Model Discussion

The debt dynamics model (Equation 3.2) in our study investigates the sovereign debt changes in China against the macroeconomic fundamental variables such as domestic debts, foreign debts, expenditures, revenues, GDP growth, domestic debt interest rates, foreign debt interest rates and foreign exchange losses/gains. The equilibrium sovereign debt index of China can be calculated based on the model estimates (see Figure 4.1).

Figure 4.1 China's Sovereign Debt and Equilibrium Sovereign Debt



Source: Author's calculation

Figure 4.1 shows the dynamics of the sovereign debt index and the equilibrium sovereign debt index in China. Both index lines indicate the increase rate of sovereign debt level and their equilibrium level. The large gap between the sovereign debt index and its equilibrium value suggests that a sovereign debt problem exists in China. China's 2008 economic stimulus package required the Chinese government to spend RMB4 trillion in infrastructure and public transport projects in order to maintain China's GDP growth during the 2008 global financial crisis period, which significantly increased the sovereign debt index since 2009. From 2009 to 2012, China's sovereign debts surged almost 1.5 times (Li, 2013). The increase in China's sovereign debts is mainly attributed to the government over spending (Fan & Lv, 2012). Consequently, China's sovereign debt index nearly exceeded its equilibrium value by 25% during the period 2009-2013.

This large gap between the debt growth of Chinese central government and its equilibrium value confirms a sovereign debt problem in China since 2009, especially after the Chinese government implemented the RMB4 trillion economic stimulus program in 2008. This is because the stimulus package invested in many areas which generated low returns (such as transport, electricity, and housing areas) (Li, 2013) and the RMB4 trillion program has been adjusted in 2010. The new version of the stimulus program included wider investment areas (such as inner-city transport, infrastructure, and environmental protection projects) and a larger investment size. By the end of 2012, the actual total spending of the Chinese government totalled RMB30 trillion, which was about 6 times more than the original stimulus plan in 2008 (Zhang, 2013a).In addition, the average growth of Chinese sovereign debts also shows the significant impact of the RMB4 trillion program: the five-year average increases in Chinese sovereign debt before and after the economic stimulus package (2004-2008 and 2009-2013) are 14.98% and 39.15%, respectively. This significant difference between the sovereign debt growth in China before and after the RMB4 trillion program suggests the dramatic impact of the economic stimulus program on the changes in the growth of Chinese sovereign debts.

4.3 Results of the Sovereign Risk Model

The sovereign risk model (equation 3.5) of the present study tests how macroeconomic fundamental variables impact China's sovereign risk via an ordered logistic model. As discussed in Section 3.2.2, the independent variables in the

sovereign risk model are in lagged term. For example, to capture the sovereign risk in time T, the model uses macroeconomic fundamental variables in time T-1. The estimated results in the sovereign risk model are presented in Table 4.3.

Table 4.3 Results of the Sovereign Risk Model (An Ordered Logistic Model)

Variable	Coefficient Estimates
Debt-revenue ratio	1.174***
	(2.732)
Debt-GDP ratio	22.796***
	(3.641)
Debt interest rate	98.032***
	(20.596)
Economic Growth	-4.47E-05***
	(-3.226)
Inflation	-15.880***
	(-22.741)
Limit Points	
Limit_3	787.5036
Limit_4	936.6469
Number of observations	19
Pseudo R-square	1.000
LR-statistic (p-value)	0.000***

Notes: t-statistics in parentheses below the estimates. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. LR-statistic presents the joint significance of the sovereign risk model.

Source: Author's calculations.

4.3.1 Sovereign Risk

According to Manasse et al. (2003), the Standard & Poor's sovereign rating is one of the important measurements of the sovereign risk. Manasse et al. argue that the Standard & Poor's sovereign rating is related to the countries' macroeconomic fundamental variables such as economic growth, inflation and public debt services, with the aim to capture a county's debt risk. The higher the Standard & Poor's sovereign rating (the highest rating is AAA, the lowest ratings are D and SD) for a country, the lower the sovereign risk in the country. Maltritz et al. (2012) successfully employed the Standard & Poor's sovereign rating as one of the sovereign risk indicators in modelling the sovereign debt risk based on an annual data set of 31 countries from 1994 to 2006. The authors argue that a country's default risk cannot be directly observed, thus researchers should use indicators such as issuance spreads, spreads on secondary bond markets, the Standard & Poor's sovereign rating and the Moody's sovereign ratings to estimate the sovereign risk. The Standard & Poor's sovereign rating is one of the most effective indicators for the sovereign risk approximation.

Based on the target of the Standard & Poor's sovereign rating, the sovereign risk can be divided into six grades: the top grade (AAA), the high quality grade (AA+, AA, AA-), the upper medium quality grade (A+, A, A-), the medium quality grade (BBB+, BBB, BBB-), the non-investment grade (from BB+ to C) and the default grade (SD and D). The present study uses six categories (1-6) to represent six sovereign risk

grades (the top grade to the default grade), respectively (such as the top grade ranked 1, the high quality grade ranked 2, etc). This suggests that the higher rank category exhibits the higher sovereign risk (for example category 4 yields a higher debt risk versus category 3). Based on the data of the sovereign risk model, China's sovereign risk fell into categories 2 to 4 during the period 1995 - 2014.

In a binary logistic regression model, the dependent variable is a probability of the study event; the value of the dependent variable is between 0 and 1. The result of a binary logistic regression model has only one limit point (0.5). When the probability falls into 0-0.5, the study event does not occur (the probability equals 0); otherwise, the model treats the study event with certainty (the probability equals 1). An ordered logistic regression model divides a binary probability (0 or 1) into more than two ordered categories such as small-middle-large, bad-good-excellent, etc. Limit points in an ordered logistic regression model's result are cut-off points, which define where one category ends and the other begins. The results of the sovereign risk model (see Table 4.3) show two limit points: the limit_3 (787.5036) and the limit_4 (936.6469). These two limit points divide the sovereign risk into three areas (less than limit_3, between limit_3 and limit_4, larger than limit_4), which represent the three risk level categories (2, 3, 4), respectively. For example, if the estimated sovereign risk (using the independent variables and their coefficients) at time T is less than limit_3, it suggests that China has a lower sovereign risk (risk level 2) at time T.

4.3.2 Debt Affordability

Debt affordability (debt to revenue ratio) captures the ability of the loan repayment; a higher debt to revenue ratio suggests a lower ability to repay the debt. This is due to government revenues pledge to the government debt repayment (Weiner, 2013). Revenues are one of the important sources for a government to repay debts; an increase in government revenues helps the government to repay the existing sovereign loans. Theoretically, a higher debt-revenue ratio can increase the sovereign debt risk; this is supported by the results in the sovereign risk model (see Table 4.3). The debt-revenue ratio coefficient is statistically significant at the 1% level and positively impacts the sovereign risk.

Similarly, Manasse et al. (2003) studied sovereign debt crises based on a data set of 47 countries from 1970 to 2002. The authors' results show a positive impact of debt to revenue ratio on sovereign risk. The authors found that debt to revenue ratio is one of the important indicators in explaining sovereign debt crises. A higher debt-revenue ratio suggests a higher probability of a sovereign debt crisis occurring. Therefore, the authors believed that the debt affordability has a strong link to sovereign defaults.

Holland, Kirby and Orazgani (2011) investigated the sovereign default and modelled the debt crisis in Europe. The authors found that sovereign defaults occur with the large imbalance between sovereign debt burden and government revenues. The imbalance between sovereign debts and government revenues represents an increasing debt to revenue ratio, which decreases debt affordability and increases the sovereign

risk. This supports the sovereign risk model's results (see Table 4.3) where the increase in debt-revenue ratio raises the sovereign risk of a country. Cantor and Packer (1996) also confirmed this dramatic impact of the debt-revenue ratio on sovereign risk. Cantor and Packer argue that the increase in government revenues increases the ability of a government to repay debts, which positively impacts the stability of a country's economy. This is attributed to a better sovereign rating.

4.3.3 Debt Burden

The World Bank and the IMF introduced a debt sustainability framework (DSF) in 2005 and reviewed it in 2012. Both the World Bank and the IMF believe the debt burden (debt-GDP ratio) is an important determinant of the sovereign risk. The DSF focuses on the present value of total government debts and sets up debt burden thresholds to warn governments when the total sovereign debt burden exceeds the threshold value. Under the DSF, the threshold of the high-risk debt burden is 50%, which implies that once the government debt to GDP ratio is over 50%, sovereign defaults may take place relatively easily.

The results in the sovereign risk model show a positive and significant (at the 1% level) relationship between debt-GDP ratio and sovereign risk. This suggests an extremely strong link between the debt burden and the sovereign risk. An increase in the sovereign debt burden (debt-GDP ratio) can increase the sovereign risk in China. Eichengreen and Mody (1999) tested the debt sustainability in East Asian countries during the period from 1991 to 1997 using macroeconomic fundamental variables

such as debt-GDP ratio, debt-export ratio, and economic growth. The authors confirmed that the sovereign debt condition is strongly impacted by the debt-GDP ratio. Further, Yue (2010) studied the sovereign default and the debt renegotiation for emerging economies including Argentina and adopted the external debt to GDP ratio, debt service to GDP ratio, and interest rate to test how debt burden and debt interest rate impact on sovereign risk. The author pointed out that the increase in the interest rate raises the cost for the government to borrow new debts; consequently, a sovereign default might occur due to the extremely high credit price. Moreover, the author observed that the interest rate tends to increase with the level of debts. This may explain the strong link between the debt burden and the sovereign risk in the results in the sovereign risk model.

4.3.3 Debt Rate

As discussed in Section 4.2.2, an increase in the interest rate raises the debt cost and further impacts the sovereign debt risk. In the sovereign risk model (equation 3.5), the debt interest rate positively and significantly impacts the sovereign debt risk at the 1% level.

Generally, sovereign debts include fixed rate bonds and floating rate loans. Fixed rate bonds are bonds issued by the government to the public at a fixed rate, while floating rate loans are the government borrowing from the open market at a floating rate influenced by the market debt rate (Moorad, 2010). Changes in the debt interest rate dramatically impact existing government loans with a floating rate. An increase in the

debt interest rate significantly increases the loan interest, which increases loan repayments, which can negatively affect the sovereign risk (Yue, 2010). Although the interest rate of fixed rate bonds does not change over time, it can be impacted by the debt interest rate. When the debt interest rate increases, creditors tend to sell tradeable bonds to raise money and lend to the open market for a higher return (Moorad, 2010). As a result, the bonds value may decrease if the debt interest rate increases. According to Yue (2010), an increase in the debt interest rate raises the cost for the government to borrow new debts, thus a sovereign default may occur when the borrowing cost is extremely high. This is because governments may not be able to roll-over sovereign debts under a high debt interest rate, which creates a huge pressure on debt repayments. When the government deficit is inadequate to repay sovereign debts on maturity, defaults could occur (Yue, 2010). Yue treats the sovereign default as one of the rational options for the government. A higher debt interest rate significantly increases the sovereign debt price. When the debt price exceeds a critical level, the cost of repaying sovereign debts may eventually be greater than the negative impact (i.e. loss in reputations) of sovereign defaults. Therefore, the governments are likely to default on their sovereign debts.

Similarly, Holland, Kirby and Orazgani (2011) confirmed the significant impact of the debt interest rate on the sovereign risk by studying the Eurozone countries' interest liability burden. The authors found that the debt interest rate determines the sovereign debt burden; the imbalance of sovereign debt burden and government revenue is one of the important contributing factors of sovereign defaults.

4.3.4 Economic Growth

Cantor and Packer (1996) believe that economic growth significantly impacts the sovereign risk. A relatively higher economic growth rate suggests that the government can serve the debt burden more easily over time, which causes economic growth to negatively impact the sovereign risk in China. In other words, the increase in economic growth will decrease the sovereign risk in a country. The results in the sovereign risk model show economic growth negatively impacts China's sovereign debt risk at the 1% level of significance. The reason behind this is China's high economic growth in the long-run. China experienced a high economic growth (average 9%) over the last three decades. The economic boom significantly increases China's GDP, which in turn decreases the debt burden in China. Further, the economic boom can increase government revenue, which helps China's government to repay sovereign debts.

Pirtea et al. (2013) studied the sovereign debt of Romania from 2000 to 2011 and found that fiscal balance, interest rate, and GDP growth significantly impact the sovereign risk. The authors argued that the debt-GDP ratio captures the country's debt burden; a higher debt burden increases the sovereign debt risk. An increase in economic growth increases the country's GDP, which decreases the debt burden and increases government revenue. This helps the country to manage the sovereign debt risk. This result supports the findings of the sovereign risk model (equation 3.5) in our study results.

Cantor and Packer (1996) investigated the main factors that affect sovereign ratings based on cross-country data (from 49 countries and areas around the world) in 1995. The authors found that GDP growth is one of the six main factors that play important roles in determining sovereign ratings (the six factors include per capita income, GDP growth, inflation, debt level, economic development level and default history). GDP growth significantly impacts the sovereign risk, which supports our study results. Cantor and Packer argued that a relatively higher economic growth increases the future government revenue, which suggests an increase in the loan repayment ability. Thus, a higher GDP growth rate helps the government to serve sovereign loans over time.

4.3.5 Inflation

The sovereign risk model reveals the inflation coefficient is negative and significant at the 1% level. This suggests that the increase in inflation can decrease sovereign debt risk. The relationship between inflation and sovereign debt risk is supported by Cantor and Packer (1996) who tested the sovereign risk of 49 countries around the world in 1995.The authors argue that using tax revenues and issuing new debts are the two common methods to repay existing sovereign loans for the government. Owing to the potential negative impact of a high inflation on a country's overall economy (Sarel, 1996), an inflationary method (increase money supply – M2) will be used only when the government is unable to repay the loan using taxes or issuing new loans, which signals a potential sovereign debt problem in the country. Thus, Cantro and Packer

conclude that inflation has a significant impact on sovereign debt risk.

Similarly, Fuertes and Kalotychou (2007) investigated the sovereign debt risk in 75 emerging countries for the period 1983-2000. The authors reported strong impacts of government revenues, GDP growth, inflation, interest rate, and debt burden on debt instabilities. The authors argued that inflation, measured by the consumer price index (CPI), captures the country's currency purchasing power and an increase in the CPI potentially devalues the country's currency value. In other words, an increase in inflation decreases the currency's purchasing power, which may devalue the country's currency. The devaluation of the country's currency increases the foreign exchange rate, which negatively impacts foreign debts. However, the increase in inflation decreases the real interest rate (interest rate - inflation), which positively impacts domestic debts. In China, domestic debt dominates total sovereign debt (see Table 4.2), thus the negative impact of inflation on China's foreign debt is extremely small compared to its impact on China's domestic debt. As a result, inflation has a positive impact on China's sovereign risk.

Similarly, Sarel (1996) found a strong link between inflation and economic growth in the long run based on a global dataset in 87 countries during 1970-1990. The author states that a relatively low inflation rate (lower than 8%) positively impacts the country's economic growth. The average CPI in our study was about 3%. Thus, inflation positively impacts the economic growth in China, which decreases China's sovereign risk due to the decrease in the debt burden (debt-GDP ratio). However, this

impact is not effective for a higher inflation rate. When the country's inflation is higher than 8%, the increase in inflation significantly decreases the country's economic growth (Sarel, 1996). The high inflation decreases the return on capital, which in turn reduces the country's investment; low investments can slow economic growth in the country (Kim, 1996).

4.3.6 Sovereign Risk Model discussion

The sovereign risk model of our study investigates the possibility of a debt crisis occurring in China. The sovereign risk of China is regressed based on macroeconomic fundamental variables such as debt affordability, debt burden, debt interest rate, economic growth, and inflation. The limit points of the ordered logistic model are 787.5036 (limit_3) and 936.6469 (limit_4) (see Table 4.3). The limit points are used to divide the sovereign risk into three ordered risk level categories: 2 (less than limit_3), 3 (between limit_3 and limit_4), and 4 (larger than limit_4). The ordered risk level categories represent the ordered level of the sovereign risk in China, category 4> category 3> category 2.

Table 4.4 Estimated Sovereign Risk of China

	Calculated value	Estimated SR	SR
1996	1095.333	4	4
1997	1175.425	4	4
1998	1158.818	4	4
1999	975.6004	4	4
2000	985.5003	4	4
2001	982.4065	4	4
2002	1017.526	4	4
2003	1007.381	4	4
2004	971.374	4	4
2005	900.0939	3	3
2006	902.0072	3	3
2007	873.4322	3	3
2008	823.6986	3	3
2009	865.6146	3	3
2010	722.9976	2	2
2011	624.9911	2	2
2012	733.1642	2	2
2013	683.0401	2	2
2014	595.0621	2	2

Notice: SR represents China's sovereign risk, which is measured by the Standard & Poor's sovereign rating; Estimated SR estimates the sovereign risk of China based on the sovereign risk model's results.

Source: Author's calculations.

Table 4.4 shows the estimated sovereign risk based on the sovereign risk model's results (calculated by the independent variables and their coefficients). The similarity of the sovereign risk and the estimated sovereign risk captures how the estimated sovereign risk level, which is based on the macroeconomic fundamental variables, deviates from the actual sovereign risk level (Standard & Poor's sovereign rating) in China during the study period from 1996 to 2014 (the estimated sovereign risk starts from 1996 due to the loss in the degree of freedom). The results in the sovereign risk

model (see Table 4.4) show similar sovereign risk level categories between the estimated sovereign risk and the actual Standard & Poor's sovereign rating, which suggests the sovereign risk model performs well in measuring China's sovereign risk.

Further, the model estimates the sovereign risk in China in time T based on the independent variables at time T-1 (see Section 3.2.2). As a result, this model can be treated as an early warning system for China's sovereign debt risk. According to Ciarlone and Trebeschi (2005), an early warning system model (EWS model) is a model that both identifies the weakness of the economies and signals the onset of a financial crisis. For example, Kaminsky, Lizondo, and Reinhart (1998) introduced a currency crises EWS model based on the Mexican peso crisis in 1994 and Berg and Pattillo (1999) successfully used a currency and banking EWS model to predict the 1997 Asian financial crisis (as cited in Berg, Borensztein, & Pattillo, 2005). Compared with EWS models in the currency and banking areas, the number of debt risk early warning system models is relatively small. This may due to the country heterogeneity that significantly impacts the debt risk EWS model's performance in different countries. Further, there is no consensus agreement on the question of how dummy variables capture the country's heterogeneity in cross-country data (Fuertes & Kalotychou, 2006).

The sovereign risk model may be a suitable EWS model for a sovereign crisis for China. Based on macroeconomic fundamental variables (at time T), the sovereign risk model estimates the sovereign risk of China for the coming year (time T+1). This

provides the Chinese government with an overview of the sovereign risk condition for the coming year in which the Chinese government can make an early decision or preparation for a potential debt risk in China. The sovereign risk model (equation 3.5) potentially provides an opportunity for the Chinese government to manage the sovereign debt risk for the following year by implementing fiscal and monetary policies to influence the macroeconomic fundamental variables in the model. This provides a potential mechanism for the Chinese government to manage the sovereign risk in the future.

Further, one of the objectives of the present study is to provide policy implications to avert a potential debt crisis in China. The sovereign risk model not only provides a prediction of the sovereign debt risk in China, but also investigates how macroeconomic fundamental variables impact on the sovereign debt risk in China. Based on the results in the sovereign risk model, debt affordability (debt-revenue ratio), debt burden (debt-GDP ratio), and debt interest rate positively impact the sovereign debt risk in China, while economic growth and inflation negatively impact China's sovereign debt risk. However, using economic growth and inflation to adjust China's sovereign risk is difficult; because it is difficult to increase economic growth and a high inflation (over 8%) harms the country's economy (Sarel, 1996). Therefore, the options left for the Chinese government to manage the sovereign risk are to control the debt affordability and debt burden. Debt-GDP ratio and debt-revenue ratio positively impact the sovereign debt risk in China based on the results in the sovereign risk model. This suggests that an increase in government revenues and a

decrease in sovereign debts can help to decrease the sovereign debt risk in China.

4.4 Results of the Bank Risk Model

The present study also investigates how sovereign risk impacts bank risk in China based on a bank risk model (equation 3.6). The model captures bank risk affected by macroeconomic fundamental variables such as country characteristics (economic growth, inflation, sovereign risk and government debt interest rate) and bank characteristics (non-performing loan rate, profit per share, capital adequacy ratio and bank ownership). The bank risk model in the present study tests how the sovereign debt risk impacts bank risk in China (including state-owned banks and corporate banks). The estimated results of the bank risk model are presented in Table 4.5.

Table 4.5 Results of the Bank Risk Model

Variable	Coefficient Estimates
Sovereign risk	0.690***
	(5.000)
Economic growth	11.945***
	(2.624)
Inflation	-0.142***
	(-3.662)
Debt interest rate	0.579***
	(4.041)
Profit per share	0.032
	(0.241)
Non-performing loan rate	-0.180***
	(-3.761)
Capital adequacy ratio	0.010
	(0.096)
Bank ownership	0.316*
	(1.760)
Year	-0.036
	(-1.209)
Number of observations	69
LR statistic	23.71
Prob (LR statistic)	0.005***

Notes: t-statistics is in parentheses. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. F-statistic presents the joint significance of the bank risk model.
Source: Author's calculations.

4.4.1 Effects Specification

The bank risk model (equation 3.6) is an unbalanced panel data model based on 8

selected banks (four large-sized state-owned banks and four small- and mid- sized corporate banks) in China from 2006 to 2014. Banks in China include state-owned banks and joint-equity corporate banks. The state-owned banks also called “the big four” are large sized banks; while joint-equity corporate banks are small- and mid-sized banks. The present study selects an equal amount of both state-owned banks and joint-equity corporate banks in order to avoid a potential bias issue due to the bank type. Based on the data availability, the data set for the bank risk model (equation 3.6) is an unbalanced panel data set.

The unbalanced panel data can be balanced, but according to Kerstens and Woestyne (2014), balancing the unbalanced panel data can lose large amounts of information. The authors point out that due to the large information losses, the model results based on the balanced and the unbalanced panel data can be significantly different. Baltagi and Chang (1994) further explained that the more data losses in balancing an unbalanced panel date, the less efficient the model will be. The authors attempted to balance the unbalanced data from Harrison and Rubinfeld’s (1978) study(1) and concluded that balancing an unbalanced panel data shows a poor model performance and the performance becomes worse with the number of observations deleted (while balancing the panel data). If we balance the unbalanced panel data set of the bank risk model (equation 3.6) in our study, we will lose over 20% of the information. As a result, we use the unbalanced panel data in estimating the bank risk in China.

For any regression, heteroscedasticity and autocorrelation are two major problems

(1) Harrison and Rubinfeld’s (1978) study on the housing prices in Boston area in the 1970s using an unbalanced one-way model with period random effects

that need to be carefully dealt with. Our data set suffer from autocorrelation problem since it failed the Wooldridge test; thus, we estimate the generalised least square (GLS) regression model (bank risk model) by using Newey-West (HAC) method, which can eliminate both autocorrelation and heteroscedasticity in the model.

4.4.2 Bank Risk Measurement

The dependent variable Z in the bank risk model (equation 3.6) is the Z-Score that captures bank risk such as bank performance, bank profitability, and bank volatility (Buch et al., 2013). The Z-score is a function of capital-asset ratio, return on assets and the standard deviation of assets return. Z-score is widely used to capture bank risk and Buch et al. (2013) tested how sovereign risk impacts on bank risk based on the quarterly German banks' data from 2005 to 2010. The authors used the Z-score to measure bank risk and successfully capture the strong link between banks risk and sovereign risk. The sovereign risk of one country significantly impacts the value of the country's debt, which affects the performance of banks that hold the country's government bonds. Similarly, Demirguc-Kunt & Huizinga (2010) employed the Z-score to test the impact of the bank's activity and the bank's short-term funding strategy on bank risk. The authors state that the Z-score captures the probability of the bank's insolvency, which is a key estimator for bank risk. Based on the definition of the Z-score (equation 3.7), the Z-score increases with higher capital adequacy (capital-asset ratio) or/and higher profitability (return on assets) or/and lower profit stability (assets return volatility) of banks. According to Demirguc-Kunt & Huizinga

(2010), the Z-score is a measure of the bank's solvency; a higher Z-score implies a lower probability of the bank's insolvency. In other words, a higher Z-score represents lower bank risk in the bank risk model.

4.4.3 Country Characteristics

Country characteristics such as economic growth, sovereign risk, inflation and debt interest rate significantly impact bank risk in the bank risk model (see Table 4.5). Economic growth (GDP growth), sovereign risk, and debt interest rate positively impact bank risk (Z-score) in China, while inflation has a negative impact on bank risk in China. In this section, we will discuss the relationship between country characteristics and the Z-score.

The increase in economic growth in China will increase the Z-score, in other words, decrease bank risk. The results in the bank risk model (see Table 4.5) show GDP growth has a positive impact on the Z-score (significant at the 1% level). A relatively higher economic growth rate potentially generates higher tax revenues, which suggests the government could serve the debt burden relatively more easily over time, thereby decreasing the sovereign debt risk. This may benefit banks because the decrease in the sovereign debt risk lowers the default risk of government loans that the banks hold. Levine and Zervos (1998) examined the long-run relations between economic growth, banks, and stock markets. The authors found that economic growth has a negative impact on bank risk. In addition, Levine (1998) confirmed this relationship between economic growth and bank risk. The author reports that

economic growth negatively impacts bank risk because economic growth is strongly linked to the bank performance. Levine argues that an economic boom helps to increase banks' profitability and decrease banks' non-performing loan rate, which significantly increases the banks' performance. In addition, credit demands tend to increase during an economic boom period, which leads creditors (including banks) to implement a stricter credit rationing (Levine, 1998). This may lower the credit risk for banks. The above findings of Levine (1998) and Levine and Zervos (1998) support the results in our bank risk model (see Table 4.5) that the increase in GDP growth decreases bank risk in China.

The impact of inflation on bank risk in China is negative (-0.142) and statistically significant at the 1% level. This implies that a 1% increase in inflation will decrease Z-score in China by 0.142%. Demirguc-Kunt and Huizinga (2010) tested bank risk and return based on 1334 banks in 101 countries. The authors found a strong relationship between bank risk and inflation because the inflation rate affects the bank performance and influences credit decisions of banks. Based on the authors' argument, a higher inflation leads to a higher fee income ratio (the non-interest income over the total operating income) and a higher non-deposit fund ratio (the non-deposit fund over total deposits and the short-term funding) which negatively impact the bank's stability. As a result, inflation may negatively impact bank risk which supports our results in the bank risk model (see Table 4.5).

The government debt interest rate exhibits a positive impact on bank risk at the 1%

level of significance. The government debt interest rate captures the interest rate of debts (or the discount yield of government bonds). Higher debt interest rates increase the potential returns on debts that positively impact on bank profitability (assuming that debts will not default). Based on the Z-score definition (equation 3.7), bank profitability has a positive relationship with the Z-score. Thus, the results in the bank risk model show a positive impact of the debt interest rate on the Z-score. Similarly, Kohler (2012) tested bank risk by regressing the banks' Z-score on 15 EU countries from 2002 to 2009 and found that the Z-score of banks is positively impacted by the debt interest rate. The author argues that the debt interest rate significantly impacts the bank's interest income; a lower share of the non-interest income to the total bank income increases the bank's stability, which decreases bank risk.

The objective of the bank risk model (equation 3.6) is to test the impact of sovereign risk on bank risk in China. The estimated results (see Table 4.5) show a positive relationship between the Standard & Poor's sovereign rating (the sovereign risk indicator) and the Z-score (significant at the 1% level). This implies that bank risk tends to be positively impacted by sovereign debt risk. One possible reason of the strong link between sovereign debt risk and bank risk is due to the impact of sovereign risk on the bank's profitability. According to Gennaioli et al. (2014), investors tend to withdraw their credits when a sovereign debt problem occurs; this leads to panic sales in tradable government bonds, which decreases the market value of government bonds. Bank performance will be negatively impacted especially for banks that hold a large number of government bonds. As a result, the sovereign debt

risk significantly impacts the bank's performance. For example, Blundell-Wignall and Slovik (2011) studied the 2010 European debt crisis and found that banks that held large numbers of sovereign debts of PIIGS countries experienced up to 50% haircuts on the sovereign debt assets value. The authors further reported that these banks' performances were significantly impacted by the sovereign crisis in Europe. As a result, the authors concluded that the sovereign debt risk strongly impacted bank risk. Table 4.6 shows the information of Chinese government bonds held by selected commercial banks in 2015, which supports the positive link between sovereign debt risk and bank risk in China. In addition, Bernanke (1983) reported that sovereign defaults directly increase credit costs. Following this, medium/small size firms may go bankrupt, which in turn increases the non-performing loan rate of banks. This may lead to a bank crisis. These studies support the positive impact of sovereign risk on bank risk in our results (see Table 4.5). China's sovereign risk decreased over the study period from 2006 to 2014 and bank risk in China also experienced a reduction during the same period. The decrease in both sovereign risk and bank risk in China may be partially due to the long-run relatively high economic growth in China (an average of 9% in GDP growth) (Das, Fiechter & Sun, 2013). In addition, the results in the bank risk model show a positive link between sovereign risk and bank risk; this positive impact contributes to the similar trends of the Z-score index and the Standard & Poor's sovereign rating in China.

Table 4.6 Chinese Government Bonds Held by Selected Commercial Banks in 2015

Selected commercial banks	Chinese government bonds held in 2015 (billion RMB)
Bank of China	1411.5
China Construction Bank	1851.6
Industrial and Commercial Bank of China	1468.7
Agriculture Bank of China	1231.3
State-owned commercial banks subtotal	5963.1
China CITIC Bank	165.2
China Everbright Bank Co., Ltd	439.1
China Merchants Bank	171.1
Industrial Bank Co., Ltd	421.5
Joint-equity commercial banks subtotal	801.7
Total	6764.8

Source: Annual report of selected commercial banks, 2015

4.4.4 Bank Characteristics

Different banks may be impacted by sovereign risk differently in terms of the bank's characteristics. The bank characteristics include non-performing loan rate, profit per share, capital adequacy ratio and bank ownership dummy.

The profit per share captures the profitability of banks which positively impacts the Z-score. According to Kohler (2012), bank profitability is one of the determinants of bank risk because higher profitability generates higher returns that increase the ability of banks to deal with sudden shocks. Similarly, the capital adequacy ratio has a positive impact on the Z-score. This is attributed to a higher bank capital share to the total risk-weighted asset, which increases the banks' stability (Kohler, 2012). Both the profit per share and capital adequacy ratios increased from 2006 to 2014 for selected banks of China, which potentially contributed to the increase in the Z-score index of Chinese banks. The present study observes an increasing Z-score of China's banks

from 2006 to 2014; the average annual Z-score increase rate is about 3.68% in China. This suggests bank risk decreased in China during the period from 2006-2014.

However, the results in the bank risk model show the coefficients of profit per share and capital adequacy ratio are insignificant. This is because of China's high economic growth in the long run (averaging over 10% per year since the 1980s) and the bank bailout policy of the Chinese government. Firstly, the long-run high economic growth in China may create a positive economic environment expectation that the economic boom in China will not slow down in the future. This may encourage banks to ignore the risk. Mendoza and Terrones (2008) explained that the credit expansion is associated with economic booms. During the credit expansion period, banks tend to over lend and ignore risks of loans. Secondly, based on the old deposit insurance policy of China, no banks were allowed to go bankrupt in China before 1st of May, 2015 (Chinese Government document number [660], 2015). To ensure banks have enough credits to avoid a bank failure, the old deposit insurance policy stipulates that the People's Bank of China has the responsibility to bail out any large losses suffered by Chinese banks. This leads to moral hazard behaviour, which further encourages Chinese banks to take larger risks. Both of these factors may impact Chinese banks and contribute to the insensitivity of the bank's risk-taking in China. Profit per share measures the profitability of banks and capital adequacy ratio captures the stability of banks, which are two important bank risk measurements (Cheng, Zhao & Zhang, 2013). The insensitivity of the risk-taking in China's banks potentially explains the insignificant impacts of profit per share and capital adequacy ratio on bank risk in the

bank risk model (see Table 4.5).

The non-performing loan rate (dead loan rate) coefficient shows a negative impact on the Z-score at the 1% significance level in the bank risk model (see Table 4.5). This suggests that bank risk increases with the increase in non-performing loan rate. The coefficient of the non-performing loan rate is -0.180, which implies that the Z-score will decrease by 0.18% when the non-performing loan rate increases by 1%. Li et al., (2009) investigated non-performing loans and bank efficiencies in 40 Taiwanese commercial banks from 1996 to 2007. The authors found that the non-performing loan rate significantly impacted bank risk in terms of the decrease in bank efficiency and bank profit. The author reported that a higher non-performing loan rate reduces the banks' aspiration to issue new loans, which directly decreases bank profit. The present study observes a decreasing non-performing loan rate in selected Chinese banks from 2006 to 2014. The decrease in the non-performing loan rate is attributed to the stable economic environment and the long-run high economic growth of China (Li & Carmen, 2013). Based on the regression results in the bank risk model (see Table 4.5), the decrease in Chinese banks' non-performing loan rate will significantly increase the Z-score of Chinese banks, which decreases bank risk in China. According to Cheng, Zhao and Zhang (2013), the non-performing loan rate, profit per share, and capital adequacy ratio are three common indicators which impact bank risk. Among the three indicators, we observe that the non-performing loan rate is the only significant indicator in the bank risk model. A possible reason is the impact of the non-performing loan rate on the banks' lending behaviour. Alhassan, Brobbey and

Asamoah (2013) studied the banks' lending behaviour in Ghana from 2005 to 2010 and found that bank lending behaviour mainly depends on the non-performing loan rate level. The authors argue that different non-performing loan rate levels among the loan sectors such as the housing loan sector, government loan sector, corporate loan sector, etc significantly impact bank decisions on the credit allocation, which in turn impacts bank profit.

The bank ownership in our bank risk model is a dummy variable that captures state-owned banks. Banks in China are separated into two different types: government owned banks (large size banks) and joint-equity corporate banks (medium-small size banks). Bank ownership significantly impacts bank risk in China at the 10% significance level. The coefficient of the bank ownership dummy is 0.316, which implies that state-owned banks have a relatively lower risk than joint-equity corporate banks in China in spite of other factors. Bonin et al. (2005) tested bank performance and efficiency from 1996 to 2000 for 225 banks in transition countries. The authors confirm that the government ownership is one of the determinants of bank performance and has a significant impact on bank risk. This significant impact of the government ownership on bank risk could be attributed to the higher return on investments for state-owned banks in China. Many government dominated investment projects with potentially higher returns (such as high rate government bonds and infrastructure industries, including power, water, electricity, high-speed railway) are only open to state-owned banks in China, which may cause such banks to perform better than joint-equity corporate banks. Similarly, Bonin et al. (2005) investigated

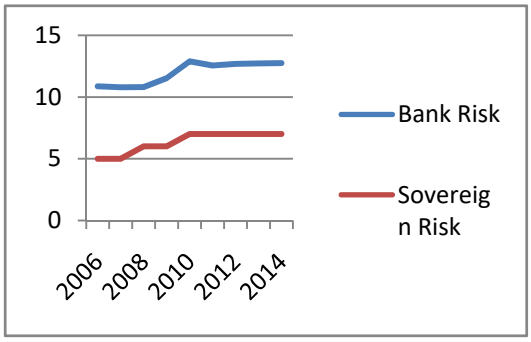
bank performance and efficiency in 225 banks of transition countries from 1996 to 2000 and found that the return on equity of government-owned banks was significantly higher than that of joint-equity corporate banks. Further, state-owned banks may be bailed out by the Chinese government for potentially large losses because of the government ownership and too big to fail policy; however, joint-equity corporate banks may receive no or minimal help from the government.

4.4.5 Bank Risk Model Discussion

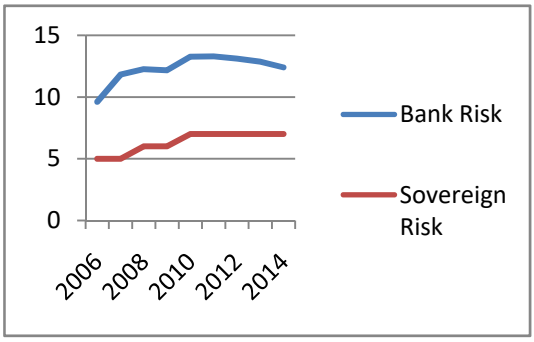
One of the objectives of this study is to investigate the relationship between bank risk and sovereign risk in China. In other words, how does sovereign risk impact bank risk in China? The bank risk model captures China's bank risk affected by macroeconomic fundamental variables such as country characteristics (economic growth, inflation, sovereign risk and debt interest rate) and bank characteristics (non-performing loan rate, profit per share, capital adequacy ratio and bank ownership).

The result of the bank risk model confirms a strong positive relationship between sovereign risk and bank risk in China. Banks selected in our study include the four big state-owned banks (Bank of China, China Construction Bank, Industrial and Commercial Bank of China and Agriculture Bank of China) and four small-medium sized joint-equity corporate banks (China CITIC Bank, China Everbright Bank, China Merchants Bank and Industrial Bank Co., Ltd). Further, the results in the bank risk model also confirm that bank ownership has a significant impact on how sovereign risk affects bank risk.

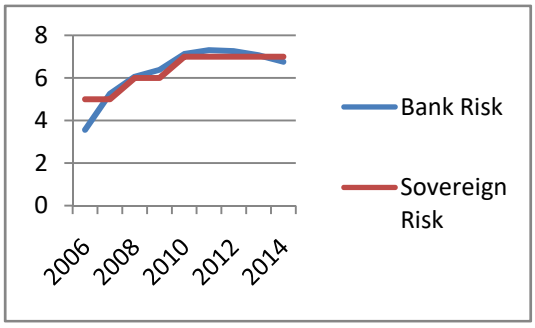
Figure 4.2 Bank Risk and Sovereign Risk of China 2006-2014



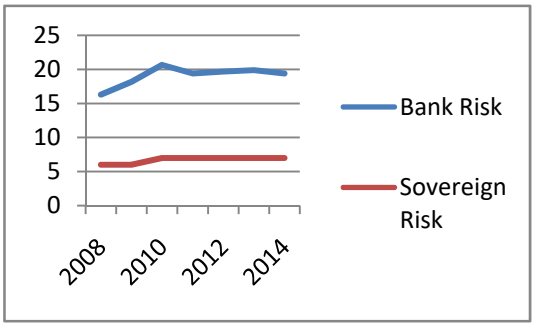
Bank of China



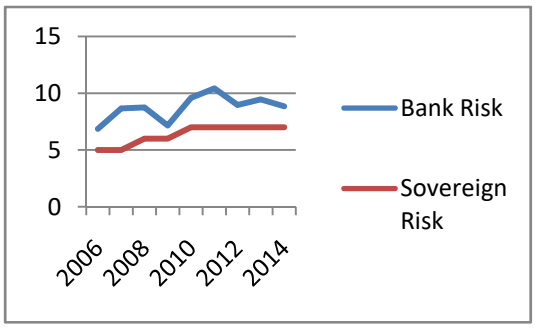
China Construction Bank



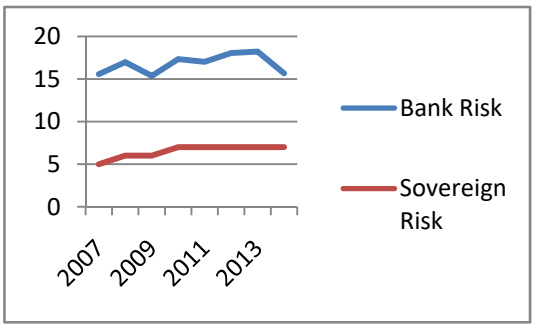
Industrial and Commercial Bank of China



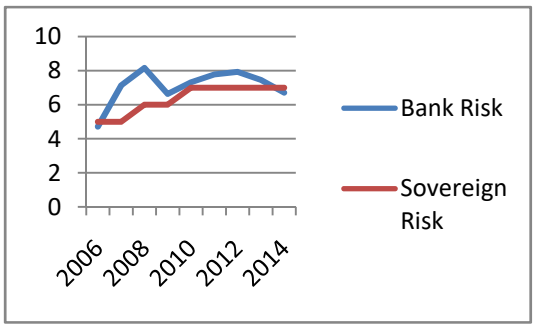
Agriculture Bank of China



China CITIC Bank



China Everbright Bank



China Merchants Bank

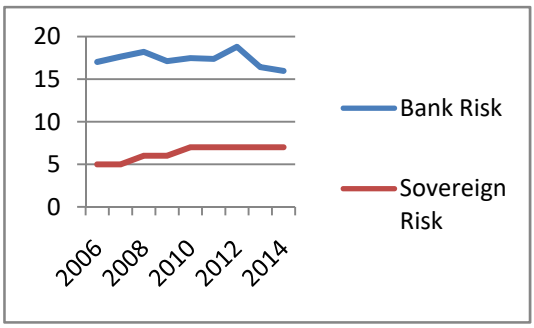


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Figure 4.2 shows the difference between the sovereign risk index and the bank risk index in China. The first four figures refer to Chinese state-owned banks and the other four figures refer to joint-equity corporate banks of China. Clearly, the bank risk index and the sovereign risk index move in a similar trend for all selected banks; however, the similarity of the fluctuation between the sovereign risk index and the joint-equity corporate bank risk index in China is lower. This is attributed to the significant impact of the bank ownership in China where state-owned banks are more closely linked to the Chinese government due to many higher return investments (such as high rate government bonds) available only to state-owned banks in China (John, 2011). More importantly, under the current policy, state-owned banks in China will not be insolvent and larger losses of Chinese state-owned banks will be bailed out by the People's Bank of China (Chinese government document [660], 2015), whereby only joint-equity corporate banks can go bankrupt. This suggests that joint-equity corporate banks in China may not receive such help (bailouts and security from being insolvent) from the government (Bonin et al., 2005). This potentially can partially transfer the bank risk of state-owned banks to the Chinese government, which contributes to the stronger link between sovereign risk and bank risk of state-owned banks compared with that of joint-equity commercial banks in China.

4.5 Conclusion

This chapter presents the estimated results of three models: the debt dynamics model, the sovereign risk model and the bank risk model. The debt dynamics model (equation

3.2) tests sovereign debt changes in China. The estimated results of the debt dynamics model show the sovereign debt in China is mainly impacted by domestic debts, government expenditures, and economic growth. Domestic debts occupy more than 98% of total sovereign debts in China, which contributes to the insignificant impact of external debts on China's sovereign debt dynamics. Government revenue has marginal effects on China's sovereign debt changes due to the long-run high GDP growth in China, which generates increasing tax revenues in the future. The sovereign risk model (equation 3.5) investigates what and how factors impact China's sovereign debt risk. Debt affordability, debt burden, debt interest rate, economic growth and inflation are estimated to have significant impacts on the sovereign debt risk. The model is an ordered logistic model, which can be used as an early warning system for the sovereign risk in China (the dependent variable falls into a higher category which suggests a higher sovereign risk in China). The bank risk model (equation 3.6) tests how bank risk is affected by the sovereign debt risk in China. Based on the estimated results in the bank risk model, macroeconomic fundamental variables such as country characteristics (economic growth, inflation, sovereign risk and government debt yield) and bank characteristics (non-performing loan rate and bank ownership) statistically impact bank risk in China. The model successfully captured the strong positive link between sovereign debt risk and bank risk in China.

Chapter 5

Conclusion

5.1Introduction

Chapter five summarizes the results and findings of the study. Section 5.2 presents an overview of the study. Section 5.3 describes the results of study objectives. Section 5.4 presents the policy implications of the study. Limitations of the study are discussed in Section 5.5 and recommendations for future researches are provided in Section 5.6. Section 5.7 concludes the study.

5.2Overview of the Study

The sovereign risk has increased the attention of economists in recent years, especially the EU debt crisis in 2009. The sovereign debt problem first broke out in Greece in 2009 and quickly spread to PIIGS countries, which fuelled the recent European debt crisis. The 2009 EU debt crisis contagiously harmed the financial system and the overall economy of the entire Eurozone. For example, three bailout packages (in 2010, 2012, and 2015, respectively) have been made to deal with the sovereign debt problem in Greece and the total bailout amount from the European Union to Greece was USD321 billion during 2010-2015. The IMF also participated in the first two bailouts in 2010 and 2012 and paid an additional USD49 billion to help the Greek debt problem.

An outbreak of the sovereign debt problem may significantly impact other financial

sectors, especially the bank sector through spillover effects. This happens when banks hold a significant amount of government debts, which negatively impacts the collateral value of government loans (De Bruyckere, Gerhardt, Schepens & Vennet, 2012). Evidence can be found in the current Eurozone debt crisis. According to Angeloni and Wolff (2012), banks' stock prices are strongly linked to the sovereign debt holdings of PIIGS countries following the outbreak of the European debt crisis. A negative shock in one market (sovereign debt issues in PIIGS countries) can directly impact the collateral values and cash flows associated with securities in the bank sector (banks that hold large amounts of government debts of PIIGS countries) (Kaminsky, Reinhart & Vegh, 2003). This significant impact of sovereign debt defaults on banks suggests that a sovereign debt crisis can easily lead to a bank crisis (Reinhart & Rogoff, 2010).

In general, the sovereign debt burden (debt-GDP ratio), sovereign debt affordability (debt-revenue ratio), sovereign debt interest rate, external government debt maturity, economic growth (GDP growth), and inflation are believed to have significant impacts on sovereign debt risk. Most of the studies on sovereign debt issues focused on the impact of external debts and external debt-GDP ratio on sovereign debt risk (Krueger, 1987; Euromoney, 1992; Kaminsky & Pereira, 1996; Boonman et al., 2013; Reinhart & Rogoff, 2010). However, other macroeconomic fundamentals also play important roles in determining sovereign debt risk. For example, the external government debt maturity length is introduced to explain why Mexico defaulted on its sovereign debts with a relatively low sovereign debt burden (20.2%) in 1994; a longer maturity length

helps to hedge the economic uncertainty risk (Cole & Kehoe, 1996; Eichengreen & Mody, 1999; Arteta & Hale, 2008; Desgranges & Rochon, 2014). In addition, government debt interest rate determines the price of sovereign debts, which significantly impacts sovereign debt risk (Yue, 2010). Holland, Kirby and Orazgani (2011) found the imbalance between sovereign debts and government revenues significantly contributes to sovereign debt defaults. GDP growth decreases the sovereign debt burden and increases tax revenues in the future, which helps the government to repay sovereign debts (Cantor & Packer, 1996; Fuertes & Kalotychou, 2007). Inflation captures the increase in overall prices, which generates pressures on foreign exchange rate through the change in currency purchasing power. This may negatively impact the external sovereign debts of a country, which affects the sovereign debt risk (Cantor & Packer, 1996; Fuertes & Kalotychou, 2007; Thornton & Vasilakis, 2016).

In regard to China's sovereign debt condition, China experienced an increase in sovereign debts during the study period of 1995-2014; the annual increase in the rate of sovereign debts in China was 20%. Following the implementation of an economic stimulus program in 2008, the speed of increase in China's sovereign debts was extremely high; China's government debts at the end of 2015 were approximately three times higher than those of 2006 (see Table 1.2). The dramatic increase in sovereign debts fuelled the high debt burden of the Chinese government, which potentially increases the sovereign debt risk in China (Hinds, 2013). However, there is limited literature on the sovereign debt risk in China (Hou, Li, Li, & Mao, 2012; Fan

& Lv, 2012; Li, 2012). The existing literature only focuses on the relatively large increase in macroeconomic indicators, such as the huge increase in Chinese government spending (Hou et al., 2012) and the increasingly large amount of central and local government loans (Fan & Lv, 2012; Li, 2012) since 2008, without providing any statistical tests on the long-run relationship between sovereign risk and macroeconomic fundamentals in China. To gain a better understanding of the sovereign risk and its impacts in China, the current study attempts to investigate sovereign debts, sovereign debt risk, and the spillover effect of the sovereign debt risk on bank risk in China by using the debt dynamics model, the sovereign risk model and the bank risk model, respectively.

There are four research objectives in this study. Research objective one investigates whether a sovereign debt problem existed in China over the sample period of 1995-2014, using the debt dynamics model. Research objective two examines the determinants of China's sovereign debt risk from 1995 to 2014 based on the sovereign risk model. Research objective three surveys the impact of sovereign risk on bank risk in China during 2006-2014, using the bank risk model. Research objective four provides policy implications for the Chinese government based on the empirical results. These will be discussed in Section 5.4.

5.3 Research Results

5.3.1 Results of Research Objective One

- Research Objective One: To investigate whether a sovereign debt problem is occurring in China

A debt surge in a short period suggests the existence of a sovereign debt problem (Reinhart & Rogoff, 2010). Since 2008, Chinese sovereign debts have increased over 300%, which may create a sovereign debt problem. The significant increase in China's government debts may be due to macroeconomic fundamentals: such as government expenditures, economic growth, and domestic debt interest rate. The results in the debt dynamics model (equation 3.2) show existing domestic debts, government expenditures, economic growth, and domestic debt interest rate have significant impacts on the sovereign debt of China. The existing domestic debts and domestic debt interest rate negatively impact China's sovereign debt, while economic growth and government expenditures have positive impacts on the sovereign debts of China. The negative impact of the existing domestic debts and domestic debt interest rate is due to the Chinese government potentially decreasing its borrowing of new debts under a relatively high debt burden and high borrowing cost. Economic growth directly increases the loan repayment ability of the Chinese government, which has a positive impact on sovereign debts. The increase in government expenditures requires higher revenues to pay and when expenditures exceed revenues, the Chinese government has to issue sovereign debts. This explains the positive impact of

government expenditures on the sovereign debts of China.

This study used the debt dynamics model to capture the equilibrium sovereign debt dynamics of China in the long run. The large gap between the sovereign debt in China and its equilibrium value suggests a sovereign debt problem exists in China. Consistent with some researches in China (Hou et al., 2012; Fan & Lv, 2012; Li, 2012), the debt dynamics model results suggest the existence of a sovereign debt problem in China since 2009. For example, Figure 4.1 shows the significant increase in the sovereign debt of China that far exceeded its fundamentally based equilibrium value during the period from 2009 to 2012. The reasons include:

1. The 2008 global financial crisis negatively impacted the economic growth in China; China's GDP growth rate has decreased by 7.3% (from 14.2% in 2007 to 6.9% in 2015) since 2008. The decrease in GDP growth negatively impacts revenues of the Chinese government, which decreases the ability of the government to repay its sovereign debts. This has significantly impacted the sovereign debt burden in China.
2. The economic stimulus program, which was implemented by the Chinese government in 2008, dramatically increased government expenditures in China. The large increase in government expenditures potentially increases the imbalance of the government budget (government expenditures exceed revenues), which significantly increases the sovereign debt in China. For example, Table 1.2 (see Section 1.2) showed that China's sovereign debts increased by approximately

200% from 2009 to 2015.

3. The domestic debt interest rate experienced a consistent decrease during the study period of 1995-2014. The decrease in the domestic debt interest rate decreased the credit price for the Chinese government to borrow from the open market. The decrease in credit price encouraged the Chinese government to borrow at a relatively low cost, which contributed to the increase in sovereign debts of China.
4. More importantly, the Chinese government spent extensively from the 2008 economic stimulus package on major infrastructures, such as high-speed transportation and electricity (37% of the total spending), the 2008 Wenchuang earthquake rebuild (25%), low-rent housing development (10%) and rural areas' infrastructure including road, gas and clean water facilities (10%), etc. However, these massive investments generated significantly low returns to meet the requirement of sovereign debt repayments (Li, 2013), which decreased the ability of the Chinese government to repay debts. This contributed to the increase in the debt burden of the Chinese government.

5.3.2 Results of Research Objective Two

- Research Objective Two: To examine how macroeconomic fundamentals impact China's sovereign debt risk

This study adopted the sovereign risk model (equation 3.5) to test the sovereign debt risk and predict a potential sovereign debt crisis in China. The sovereign risk model is an ordered logistic model, which measures ordered sovereign risk levels in China. The

results in the sovereign risk model suggest the sovereign debt risk in China is determined by macroeconomic fundamentals, such as:

1. Government revenues are an important source for the government to repay debts. The increase in government revenues increases the ability of the government to repay sovereign debts. Thus, government revenues are pledged to sovereign debt repayments (Weiner, 2013) and higher government revenues help the Chinese government to repay debts. Thus, the debt-revenue ratio negatively impacts sovereign risk in China.
2. A high level of debt burden suggests unsustainable sovereign debt in the country (Eichengreen & Mody, 1999; Yue, 2010). The increase in the debt burden requires a higher government budget to repay, but once the debt burden exceeds a critical level, the government is unable to repay debts and their interest, resulting in a sovereign default. Thus the increase in debt burden increases sovereign risk. The debt-GDP ratio measures the debt burden in China, which has a negative impact on China's sovereign risk.
3. The interest rate of sovereign debts determines the debt price; sovereign defaults may transpire when it is extremely expensive for governments to roll-over the existing debts (Moorad, 2010; Yue, 2010; Holland, Kirby & Orazgani, 2011). An increase in interest rate directly increases the cost to borrow new debts for the Chinese government, which potentially lead to an inability to roll-over the existing debts when the borrowing cost is extremely expensive. Under this

circumstance, a sovereign default could easily appear in China. Thus, the increase in interest rate can significantly increase China's sovereign risk.

4. Economic growth potentially decreases the debt-GDP ratio and increases the future government revenue (Pirtea et al., 2013; Cantor & Packer, 1996). A relatively high economic growth in the long run (an average of 9% over the last 30 years) positively impacts the debt burden and government revenue in China, which in turn helps to manage China's sovereign debt.
5. Most of the literature studies the impact of inflation on sovereign risk in a foreign debt context (Cantor & Packer, 1996; Fuertres & Kalotychou, 2007). However, domestic debt dominates sovereign debt in China (approximately 99% over the study period from 1995 to 2015) and foreign debt has been extremely small in proportion to the total debts of China; thus, foreign debt has an extremely low effect on sovereign risk in China. Under this circumstance, the impact of inflation on the sovereign risk of China depends on its impact on domestic debts. Inflation can decrease the credit price (the cost for the Chinese government to repay debts) by influencing the real interest rate (interest rate – inflation), which in turn decreases the domestic sovereign debt risk in China.

More importantly, the land remising fee plays an important role in China's government revenues and indirectly impacts the sovereign debt risk in China. Approximately 30% of the government revenues and funds in China were from land remising fees in 2015. The land remising fee can significantly impact the government revenue in China, which in turn affects China's sovereign debt risk. This is highly

related to the housing market in China as the Chinese government sells the right to use the land through auctions and the land remising fee is the price that housing developers pay to use the land. Housing prices can significantly impact the willingness to pay of the housing developers. During a boom time, housing developers are willing to pay higher land remising fees because the increase in housing prices increases the profit margin. On the other hand, a decrease in housing prices can easily lead to a decrease in the land remising fee, which in turn decreases the revenues of the Chinese government. Thus, there is a potentially strong link between the housing market and sovereign debt risk in China.

5.3.3 Results of Research Objective Three

- Research Objective Three: To study the link between bank risk and sovereign debt risk in China's financial market

An outbreak of a sovereign debt crisis suggests a crash in the country's credit market. This significantly increases the banks' non-performing loan rates, which may lead to a potential bank crisis (Bernanke, 1983; Arteta & Hale, 2008; Reinhart & Rogoff, 2010). This study employed the bank risk model (equation 3.6) to test the determinants of bank risk and to investigate how sovereign risk impacts bank risk in China. The findings of the bank risk model are:

1. Overall macroeconomic conditions significantly impact bank risk in China. Economic growth and debt interest rate positively impact bank risk in China,

where inflation has a negative impact on China's bank risk.

2. Non-performing loan rates negatively affect bank risk in China. This is due to the non-performing loan rates not only decreasing the banks' performance but also determining the banks' credit allocation (Li et al., 2009; Li & Carmen, 2013; Cheng, Zhao & Zhang, 2013; Alhassan et al., 2013). The non-performing loan rate of China's banks decreased significantly during the period 2006-2014, especially for state-owned banks due to the economic boom and the debt-for-equity swap plan by the Chinese government. The debt-for-equity swap plan allows banks in China sell a large number of non-performing loans to the government, which significantly increases the banks' profitability in China.
3. Bank risk is significantly influenced by sovereign debt risk in China. The reason could be a sovereign debt problem exposure which not only leads to panic sales of government bonds, but may severely impact the country's credit markets, which endangers the country's banking system (Bernanke, 1983; Gennaioli et al., 2014; Blundell-Wignall & Slovik, 2011). Banks in China hold a large number of Chinese government bonds; for example, approximately 70% of Chinese government bonds (valued over RMB5 trillion) were held by Chinese banks by the end of 2014. The influence of China's sovereign debt risk significantly impacts the banking system of China.
4. Bank ownership significantly impacts bank risk in China. In spite of other factors, state-owned banks exhibit relatively low bank risk in China due to many higher return investments available only to state-owned banks, which increases bank

performances for state-owned banks (John, 2011) and the bail-out policy for state-owned banks (Bonin et al., 2005) in China.

5.4 Policy Implications

An important objective of the current study is to provide policy implications to avoid a potential sovereign debt crisis and its impacts in China. Based on the empirical results and findings, this study provides policy implications for the Chinese government and banks to manage sovereign debt risk and its negative impacts discreetly.

The current study observed an unexpected increase in China's sovereign debts after 2009 (see Figure 1), which is due to the implementation of the 2008 Chinese economic stimulus program that significantly increased government expenditures (Fan & Lv, 2012). The massive government spending significantly increased the debt burden of China and has formed a sovereign debt problem in China since 2009 (Li, 2013). Thus, one of the suggestions of this study is that the Chinese government should start to decrease government expenditures in the budget. The large increase in government expenditures has increased the sovereign risk of China since 2009 and endangers the stability of the Chinese economy. The decrease in government expenditures may help to decrease the sovereign risk.

Second, this study provided a potential early warning system (EWS) model in China for policy makers to manage China's sovereign risk. The sovereign risk model

(equation 3.5) estimated the sovereign debt risk in China based on yearly time-series data. Macroeconomic fundamentals in the last time period (T-1): debt-GDP ratio, debt-revenue ratio, debt interest rate, economic growth, and inflation determine China's sovereign risk in the current time period (T). Thus, the sovereign risk model can provide a sovereign debt risk prediction for the next year (period T+1), based on macroeconomic fundamentals in the current year (period T), to enable the Chinese government to make concerted decisions to control the sovereign debt risk in the future.

The third policy implication of this study is that the Chinese government and banks should pay attention to the spillover effect between sovereign debt risk and bank risk. Sovereign debt risk significantly impacts bank risk in China and includes:

1. Sovereign debt risk directly impacts the value of government loans held by banks in China. The outbreak of a sovereign debt problem significantly decreases the value of government loans, which in turn increases the risk of banks that hold government loans (Gennaioli et al., 2014). The banks of China hold a large number of Chinese government bonds (over RMB11 trillion), which is approximately 70% of the total Chinese government bonds. A potential outbreak of a sovereign debt problem in China can directly lead to large losses in the government bonds that banks' hold, which significantly decreases bank performance.
2. The sovereign debt risk indirectly impacts the banking system in China through

the impact on the credit markets. Sovereign defaults significantly increase the credit cost of the country; consequently, firms may have difficulties in repaying their debts, which in turn increases the non-performing loans of the banks (Bernanke, 1983).

The impact of sovereign risk on government-owned banks is larger than that on joint-equity cooperate banks in China. The reason is due to the political interference in banks in China (Li et al., 2009). Government ownership significantly impacts the political interference in banks in China; for example, government-owned banks were observed to assume more sovereign loans in China (Xu, Gan & Hu, 2015). On the one hand, high rates of government bonds are only available to state-owned banks in China, which may contribute to the relatively high amounts of sovereign loan holdings. On the other hand, the Chinese government is able to influence the funding strategy of the state-owned banks based on its ownership, which can decrease the investment independence of banks (Thakrar, 2013). These contribute to the strong link between bank ownership and bank risk in China.

Fourth, the housing market has a significant impact on sovereign debt risk in China due to its impact on the land remising fee. As discussed in Section 5.3.3, the land remising fee plays an important role in the government revenues in China and is an important collateral source of the Chinese government to borrow from banks. Thusthe land remising fee significantly impacts sovereign risk in China. However, it can be highly dependent on the willingness to pay of housing developers. During a boom

time, relatively high housing prices increase the demand for land, which in turn increases the land remising fee. On the other hand, the decrease in housing prices can easily lead to a crash in the land remising fee. Thus, the Chinese government should be careful about potential shocks in China's housing market. The current study found a significant impact of government revenue on sovereign debt risk in China as China's government revenue is significantly impacted by the land remising fee, which is determined by the demand for land. A negative shock in China's housing market can negatively impact the housing demand, which in turn decreases the demand for land by developers. Thus, the stabilization of the housing market is essential for the Chinese government to manage China's sovereign debt risk.

5.5Research Contributions

First, since the outbreak of the sovereign crisis in Europe, many researchers have paid attention to the government debt concerns in Europe and emphasized the strong link between debt burden/level and sovereign risk in a country. In the recent years, Chinese government held an increasingly high debt level which may potential generate a sovereign debt problem endangering China's economy. However, there are limited international studies in the literature that focus on sovereign debt risk in China. In addition, the existing literature in sovereign debt problem of China only focused on the increasingly high debt level and debt burden without empirically investigating the impact of macroeconomic fundamentals on sovereign debt risk in China (see Hou et al., 2012; Fan & Lv, 2012 and Li, 2012). Hou et al (2012) focused on the imbalance

between the investment and consumption of China which suggest an unhealthy economic condition exists in China (see Section 2.6). Fan and Lv (2012) and Li (2012) discussed the increasingly large amounts of central and local government loans in China which far exceed the debt affordability of the Chinese government (see Section 2.6).Thus, our study bridges this gap by providing an empirical study on potential sovereign debt problem in China.

Second, as a widely used indicator of sovereign debt risk, S&P sovereign ratings are generally used to estimate foreign currency sovereign debt risk in the literature. However, limited studies have attempted to use S&P sovereign ratings to estimate sovereign debt risk in a country without any external sovereign debt problem. The results of sovereign risk model in our study showed significant impacts of macroeconomic fundamentals on sovereign debt risk in China, which suggests that S&P sovereign ratings may also be suitable in determining government domestic debt risk, i.e. China.

Third, section 1.5 in Chapter One discussed the significant difference between China and other countries' government bond market and banking system, suggesting the potential dramatic difference in the impact of sovereign debt risk on banking system. Thus, this study attempts to investigate the relationship between sovereign debt risks and banking system, especially for the difference between state-owned and non-state-owned commercial banks, in China. However, most existing studies investigate the sovereign debt risk in China individually. Therefore, our study

investigates the interactions between sovereign debts and other sectors such as banks and housing markets. Our results exhibit a strong link between bank risk and sovereign debt risk in China; the housing market can significantly impact the sovereign debt risk in China. The link between bank risk and sovereign debt risk in China shows the strong impact of sovereign risk on the banking system of China, especially for the state-owned banks; an outbreak of a sovereign debt problem can potentially crash the banking system in China.

5.6 Research Limitations

This study focuses on China's sovereign debt issue at the country level. The study discussed the sovereign debt bubbles/risks of the Chinese central government and the results showed high central government debt to GDP ratios consistently, especially after the 2008 financial crisis. Further, the debt dynamics model (equation 3.2) detected a large gap between total sovereign debts and the equilibrium sovereign debts of the Chinese central government, which suggests a sovereign debt problem exists in China. However, there are 31 provinces/regions in China, thus the sovereign debt situation and risk may be different among the provinces. Thus, testing the sovereign debt risk for each province in China can better our understanding of the sovereign risk at the local government level. However, owing to time constraints and data limitations (local governments' debts data are unavailable for many provinces), the investigation of sovereign debt risk at the region/province level and the differences in local governments' debt risk among 31 provinces are not included in

this study. As a result, our results only provide implications for the Chinese central government to manage sovereign risk in China at the country level; such implications may be not effective for each local government.

Owing to the data availability, this study investigates the sovereign debt dynamics and risks based on 20 years observations. The definition of the long run in economics is critical. Parkin and Bade (2015) define the long run as a time period in which all the input can be varied; there is no certain length of time period to differentiate the long run and the short run. Compared with some researchers (Reinhart & Rogoff, 2010; Fink & Scholl, 2016) who studied sovereign debt risks based on a data period over 40 years in length, the data length of this study is 20 years which may not be adequate to capture the sovereign debt dynamics and risks in the long run in China. Further, many small-middle sized banks' reports are not available to the public before 2006; therefore, this study only tests the relationship between sovereign debt risk and bank risk from 2006 to 2014. As a result, data length is a limitation of this study.

5.7 Suggestions for Further Study

We recommend future research in this topic should try to focus on the sovereign debt risk of China at both country level and region/province level. China's economic stimulus package in 2008 required both central and local governments to spend large amounts of money and local governments undertook approximately 70% of payments (RMB2.82 trillion) (Fan & Lv, 2012). This increased local governments' debt burden (Li, 2012), which potentially generated a local governments' debt problem in China.

In addition, economic and government debts' conditions in different provinces in China are significantly different. For example, the GDP of Guangdong province was more than 70 times higher than that of Tibet province in 2015 and the government debts of Jiangsu province were approximately 2 times higher than those of its neighbour, Anhui province. This suggests that local governments' debt situations (debt-GDP ratio and debt-revenue ratio) can be extremely different among different provinces in China. For example, the debt-GDP ratio of Guizhou province was as high as around 90%, which was approximately 3 times higher than the average debt-GDP ratio among provinces in China. Thus, we suggest that further studies should try to test the sovereign debt risk at the local government level in China. However, data availability at the local governments' level is poorly kept in China and the shadow bank is a serious challenge to calculate the total debt of local governments.

Asian Infrastructure Investment Bank (AIIB) was launched by China in late of 2013 with the aim to invest in the infrastructure projects of developing countries. AIIB started to operate at the beginning of 2016 and budgeted to invest USD1.2 billion in 2016. The purpose of AIIB is to develop Asia and increase regional economic growth. Until September 2016, AIIB has invested USD829 million in infrastructure programs in Bangladesh, Pakistan, Indonesia, Myanmar, and Tajikistan, which benefited China by increasing the demand for building materials and design services from China. However, the impact of AIIB in the long run is uncertain. It is important to investigate the long run benefit of AIIB on China, which may help the Chinese government to avoid a potential sovereign debt problem. Thus, we recommend future research should

focus on the impact of AIIB on economic growth, government revenue, and the trade-off relationship of China and other Asian countries, which may significantly help the Chinese government to control the sovereign debt risk.

5.8 Conclusion

A high debt burden and low debt affordability could potentially generate a sovereign debt problem. A default or rollover of sovereign debt could crash the economy of a country or even the whole region. The 1980s' Latin American debt crisis and the recent Eurozone sovereign crisis are two clear examples. These two debt crises have documented the significant impact of sovereign defaults/rollovers on the regional economy at large.

After the outbreak of the 2008 global financial crisis, exports decreased dramatically in China which drove down the GDP growth of China by 7.3%, due to the relatively high export-GDP ratio of China (approximately 40% in 2008). China's GDP growth rate decreased from 14.2% to 6.9% during the period 2008-2015. The Chinese government implemented a missive economic stimulus program to manage the negative impacts of the 2008 global financial crisis. These raised concerns about the Chinese sovereign debt risk and Hou et al (2012) suggest that the Chinese economic stimulus program, which required the Chinese government to invest RMB4 trillion during 2008-2010, contributed to the steady economic growth (approximately 10% during 2009-2010) in China. However, the imbalance between the investment and consumption of China suggests an unhealthy economic condition exists, which has

dramatically increased the Chinese sovereign debts since 2008. Fan and Lv (2012) further discuss that the increasing debt burden, which is due to the 2008 Chinese economic stimulus plan, potentially generates a sovereign debt problem in China. The outbreak of the sovereign debt problem can negatively impact the overall economy and financial system in China.

Differently from previous studies, this study not only examined sovereign debt dynamics in China, but also tested the determinants of China's sovereign risk and the impact of sovereign risk on bank risk in China.

In conclusion, the 2008 Chinese economic stimulus program significantly increased the sovereign debts of China and has generated a large sovereign debt problem in China since 2009. Macroeconomic fundamentals (such as debt-GDP ratio, debt-revenue ratio, debt interest rate, economic growth, and inflation) are the main causes of China's sovereign debt risk. The sovereign risk model (equation 3.5) tests the impacts of these macroeconomic fundamentals on sovereign risk in China and provides a mechanism for the Chinese government to manage the government debt risk by influencing such macroeconomic fundamentals. Further, the land remising fee (land prices) plays an important role in China's revenue, which suggests a strong link between the housing market and sovereign debt risk in China. Through the spillover effect, the sovereign debt risk can be transferred to the banking sector in China, especially for state-owned banks. This indicates the necessity and essentiality for the Chinese government to control China's sovereign debt risk.

The Asian Infrastructure Investment Bank (AIIB) was proposed by China and began operation in 2016. AIIB aims to invest in developing countries' infrastructure projects (mainly in Asia) to improve the development of the Asian region. The investment of AIIB can create large demands for building materials and design services; for example, the Pakistan national motorway M-4 project, which is invested in by AIIB, is designed and partially constructed by a Chinese enterprise (China Railway First Group) (Work on Gojra-Shorkot motorway begins, 2016). This potentially benefits China's economic growth and exports (Lin, 2016), thus the operating of AIIB may have significantly positive impacts on China's economy. This will help mitigate any possible sovereign default risk in China.

References:

Afonso, A. (2002). Understanding the determinants of sovereign debt ratings: Evidence for the two leading agencies. *Journal of Economics and Finance, 27*(1), 56-74

Alhassan, A. L., Brobbey, F. O., & Asamoah, M. E. (2013). Does asset quality persist on bank lending behaviour? Empirical evidence from Ghana. *Global Journal of Management and Business Research Finance, 13*(4), 1-8

Angeloni, C., & Wolff, G. (2012). Are banks affected by their holdings of government debt? *Bruegel Working Paper,* 07

Arnbjornsson, G., & Gronvold, H. (2009). The financial crisis in Iceland. European *Review of Labour and Research, 15*(1), *153-158*

Arora, V., & Cerisola, M. (2001), How does U.S. monetary policy influence sovereign spreads in emerging markets? *IMF Staff Papers, 48*(3),474-498

Arteta, C., & Hale, G. (2008). Sovereign debt crisis and credit to the private sector. *Journal of International Economics, 74,* 53-69

Asharya, V. V., & Shnabl, P. (2010). Do global banks spread global imbalances? The case of asset-backed commercial paper during the financial crisis of 2007-09. *IMF Economic Review, 58*(1), 37-73

A third bail-out gets the green light. (2015). The Economist, 15 August 2015

Augustin, R., Boustanifar, H., Breckenfelder, J., & Schnitzler, J. (2016). Sovereign to corporate risk spillovers. *European Central Bank Working Paper, 1878*

Babecky, J., Havranek, T., Mateju, J., Rusnak, M., Smidkova, K., & Vasicek, B. (2012). Banking, debt, and currency crises early warning indicators for developed countries. *European Central Bank Working Paper Series, No. 1485*

Balima, W. H., Combes, J., & Minea, A. (2017). Sovereign debt risk in emerging market economies: Does inflation targeting adoption make any difference. *Journal of International Money and Finance, 70*(2017), 360-377

Baltagi, B, H. (1985). Pooling cross-sections with unequal time-series lengths. *Economics Letters, 18*(1985), 133-136

Baltagi, B, H., & Chang, Y, J. (1994).Incomplete panels: A comparative study of

alternative estimators for the unbalanced one-way error component regression model. *Journal of Econometrics, 62*(1994), 67-89

Beck, T., Laeven, L., Levine, R., & Pennacchi, G. (2008). Special issue: Banking and bank regulation: Challenges for the future. *Journal of Financial Intermediation, 17*(4), 509-510

Berg, A., & Pattilo, C. (1999). Predicting currency crises: The indicators approach and an alternative. *Journal of International Money and Finance, 18*(4), 561-586

Berg, A., Borensztein, E., & Pattilo, C. (2005). Assessing early warning systems: How have they worked in practice. *IMF Working Papers, 52*(3), 462-502

Bernanke, B. S. (1983). Non-Monetary Effects of the Financial Crisis in the Propagation of the Great Depression. *NBER Working Paper, 1054*

Bertola, L., & Ocampo, J. A. (2012). Latin American's Debt Crisis and "Lost Decade". The Economic Development of Latin America Since Independence. *New York. Oxford University Press.*

Blot, C., Ducoudre, B., & Timbeau, X. (2016). Sovereign debt spread and default in a model with self-fulfilling prophecies and asymmetric information. *Journal of Macroeconomics, 47*, 281-299

Blundell-Wignall, A., & Slovik, P. (2011). A Market Perspective on the European Sovereign Debt and Banking Crisis. *OECD Journal: Financial Market Trends, 2(2010),* 9-36

Bonin, J. P., Hasan, I., & Wachtel, P. (2005). Bank performance, efficiency and ownership in transition countries. *Journal of Banking and Finance, 29*(1), 31-53

Boonman, T. M., Jacobs, J. P. A. M., & Kuper, G. H. (2013). Sovereign debt crises in Latin America: A market pressure approach. *University of Groningen paper 13016-EEF*.

Borensztein, E. (1990). Debt Overhang, Credit Rationing and Investment. *Journal of Development Economics, 32,* 315-335

Buch, C. M., Koetter, M., & Ohls, J. (2013). Banks and sovereign risk: A granular view. *Bundesbank Discussion Paper, 29*

Caner, M., Grennes, T., & Koebler-Geib, F. (2010). Finding the tipping point-When sovereign debt turns bad. *The World Bank Policy Research Working Paper.* 5391

Cantor, R., & Packer, F. (1996). Determinants and impact of sovereign credit ratings. *FRBNY Economic Policy Review, 10*(1996), 37-54

Cardoso, E. A. (1991). From Inertia to Megainflation: Brazil in the 1980s. NBER Working Paper 3585

Cardoso, E. A. (1992). Deficit finance and monetary dynamics in Brazil and Mexico. *Journal of Development Economics, 37*, 173-197

Chen, R. D., Gan, C., Hu, B., & Cohen, D. A. (2013). An empirical analysis of house price bubble: A case study of Beijing housing market. *Research in Applied Economics, 5*(1), 77-97

Chen, S. S., Chen, H. Y., Chang, C. C., & Yang, S. L. (2013). How do sovereign credit rating changes affect provate investment? *Journal of Banking and Finance, 37*, 4820-4833

Cheng, M., Zhao, H., & Zhang, J. (2013). The effects of ownership structure and list status on bank risk in China. *Journal of Applied Business Research, 29*(3), 695-709

Chinese Financial Department. (2011).财政部代理发行 2011 年地方政府债券发行兑付办法. (The Ministry of finance on issuing local government bonds in 2011). Chinese financial department documents number [2011] 52

Chinese Government. (2006). 国务院关于加强土地调控有关问题的通知. (State Council on strengthening the regulation on land issues). Chinese Government documents number [2006] 31

Chinese Government. (2015). 存款保险条例. (State Council on deposit insurance regulation). Chinese Government document number [660]

Chiodo, A. J., & Owyang, M. T. (2002). A Case Study of a Currency Crisis; The Russian Default of 1998. *The Federal Reserve Bank of St. Louis, 11/12(2002).* 7-18

Chovanec, P. (2009). China's real estate riddle. *Far East Economic Review, June 2009.*

Ciarlone, A., & Trebeschi, G. (2005). Designing an early warning system for debt crises. *Emerging Markets Review, 6*(4), 376-395

Cole, H. L., & Kehoe, T. J. (1996). A self-fulfilling model of Mexico's 1994-1995 debt crisis. *Journal of International Economics, 41*(1996), 309-330

Corsetti, G., Pesenti, P., & Roubini, N. (1999). What caused the Asian currency and financial crisis? *Japan and the World Economy, 11*(3), 305-373

Cottarelli, C. (2012). Sovereign debt crisis: Why in Europe and not elsewhere? *Intereconomics, 2012*(1), 74-75

Cui, R. (2012). Causes and enlightenments of European debt crisis on China' participation in East Asia's monetary cooperation. *Canadian Social Science, 8*(6), 179-181

Das, U. S., Fiechter, J., & Sun, T. (2013). *China's Road to Greater Financial Stability: Some Policy Perspectives.* Washington DC, US: International Monetary Fund. August 2013

Datz, G. (2012). The inextricable link between sovereign debt and pensions in Argentina, 1993-2010. *Latin American Politics and Society, 54*(1), 101-126

De Bruyckere, V., Gerhardt, M., Schepens, G., & Vennet, R. D. (2012). Bank/Sovereign risk spillovers in the European debt crisis. *NBB Working Paper* No. 232

Demirguc-Kunt, A., & Huizinga, H. (2010). Bank activity and funding strategies: The impact on risk and returns. *Journal of Financial Economics, 98*(3), 626-650

Desgranges, G., & Rochon, C. (2014). Optimal maturity structure of sovereign debt in situation of near default. *IMF Working Paper, WP/14/168*

Detragiache, E., & Spilimbergo, A. (2004). Empirical models of short-term debt and crises: Do they test the creditor run hypothesis? *European Economic Review, 48*, 379-389

Drudi, F., & Giordano, R. (2000). Default risk and optimal debt management. *Journal of Banking and Finance, 24*, 861-891

Duncan, G. (2008). IMF bailout of Iceland is delayed until fate of UK savers' frozen cash is resolved. *The Times. October, 24, 2008.* P.59

Dyer, G. (2008). Beijing offers just a quarter of stimulus funds. *The Financial Times.* Retrieved from http://www.ft.com/home/asia

Eichengreen, B., & Mody, A. (1999). Lending booms, reserves and the sustainability of short-term debt: Inference from the pricing of syndicated bank loans. *NBER Working Paper, No. 7113*

Eyssel, T., Fung, H. G., & Zhang, G. Y. (2013). Determinants and price discovery of China sovereign credit default swaps. *China Economic Review, 24,* 1-15

Fan, G., & Lv, Y. (2012). Fiscal prudence and growth sustainability: An analysis of China's public debts. *Asian Economic Policy Review, 7*(2012), 202-220

Fink, F., & Scholl, A. (2016). A quantitative model of sovereign debt, bailouts and conditionality. *Journal of International Economics, 98*, 176-190

Fioramanti, M. (2008). Predicting sovereign debt crises using artificial neural networks: A comparative approach. *Journal of Financial Stability, 4*, 149-164

Fuertes, A, M., & Kalotychou, E. (2007). Optimal design of early warning systems for sovereign debt crises. *International Journal of Forecasting, 23*, 85-100

Genberg, H., & Sulstarova, A. (2008). Macroeconomic volatility, debt dynamics, and sovereign interest rate spreads. *Journal of International Money and Finance, 27*(1), 26-39

Gennaioli, N., Martin, A., & Rossi, S. (2014). Banks, government bonds, and default: What do the data say? *IMF Working Paper, 14*/120

Gil-Daiz, F. (1998). The origin of Mexico's 1994 financial crisis. *Cato Journal, 17*(3), 303-313

Greece bailout: Eurozone deal unlocks 10.3bn euro. (2016). BBC NEWS, 25 May 2016

Harrison, D., & Rubinfeld, D. L. (1978). Hedonic housing prices and the demand for clean air. *Journal of Environmental Economics and Management, 5*(1), 81-102

Helleiner, E. (2005). The strange story of Bush and the Argentina debt crisis. *Third World Quarterly, 26*(6), 951-969

Herz, B., & Tong, H. (2004). The interactions between debt and currency crisis – common causes or contagion? Universitat Bayreuth, Rechts- und WirtschaftswissenschaftlicheFakultat, 2004

Hinds, M. (2013). China's ghost cities epitomize the problem with printing money Paul Krugman-style. Retrieved from http://qz.com/

Holland, D., Kirby, S., & Orazgani, A. (2011). Modelling the sovereign debt crisis in Europe. *National Institute Economic Review, 217*, 37-46

Hou, S. A., Li, B., Li, J. Y., & Mao, H. (2012). Coping with European debt crisis: China's fiscal policy effect and orientation. *Strategic Management, 17*(2), 13-21

Hou, Y. (2009). House price bubbles in Beijing and Shanghai? A multi-indicator analysis. *International Journal of Housing Market and Analysis, 3*(1), 17-37

John, R. (2011). China's debt crisis. *ICIS Chemical Business, 280*(17), 5

Johnston, M. (2016). High debt and savings rates hinder China's economy. Retrieved from Investopedia.com

Kaminsky, G. L., & Pereira, A. (1996). The debt crisis: Lessons of the 1980s for the 1990s. Journal of Development Economics, 50(1996), 1-24

Kaminsky, G. L., & Reinhart, C. M. (1999). The twin crises: The causes of banking and balance of payments problems. *American Economic Review, 89*(3), 473-500

Kaminsky, G. L., Reinhart, C. M., & Vegh, C. (2003). The unholy trinity of financial contagion. *NBER Working Paper,* 10061

Kerstens, K., & Van de Woestyne, I. (2014). Comparing Malmquist and Hisks-Moorsteen productivity indices: Exploring the impact of unbalanced vs, balanced panel data. *European Journal of Operational Research, 233*(2014), 749-758

Khan, M. S. (1998). Capital flows to developing countries: blessing or curse? *Pakistan Development Review, 37*(4), 125-125

Kim, S. H. (1996). Inflation and economic growth revisited. *ProQuest Dissertations Publishing,* UMI: 9703808

Kinoshita, N. (2006). Government debt and long-term interest rates. *IMF Working Paper,* WP/06/63

Kitano, S. (2005). The government's foreign debt in the Argentine crisis. *Review of Development Economics, 9*(3), 368-379

Kiyotaki, N., & Moore, J. (2005). Liquidity and asset prices. *International Economic Review, 46*(2)

Kohler, M. (2012). Which banks are more risky? The impact of loan growth and business model on bank risk-taking. *Deutsche Bundesbank, 33*(2012)

Krueger, A. O. (1987). Origins of the developing countries' debt crisis 1970 to 1982. *Journal of Development Economics, 27*(1987), 165-187

Laeven, L., & Levine, R. (2009). Bank governance, regulation and risk taking. *Journal of Financial Economics, 93*, 259-275

Lane, P. R. (2012). The European sovereign debt crisis. *The Journal of Economic Perspectives, 26*(3), 49-67

Latin America: The wrong debt crisis? (1992). *Euromoney,* Sep 1992. P.122

Lavern, M., Wayne, R., & Gooboon, K. (2006). Public debt, money supply, and inflation: A cross-country study and its application to Jamaica. *IMF Working Papers,* WP/06/121

Levine, R. (1998). The legal environment, banks and long-run economic growth. *Journal of Money, Credit and Banking, 30*(3), 596-613

Levine, R., & Zervos, S. (1998). Stock markets, banks and economic growth. *The American Economic Review, 88*(3), 537-558

Levy-Livermore, A. (1995). Economic analyses of financial crises. Ashgate Publishing Limited, Avebury, England.

Li, J., & Carmen, N. K. (2013). The normalization of deviant organizational practices: The non-performing loans problem in China. *Journal of Business Ethnics, 114*, 643-653

Li, M. (2012). China's local government debt crisis. *SERI Quarterly, 5*(2), 33-39

Li, X. (2013). Banks halt lending amid tighter liquidity. Retrieved from http://english.caixin.com/

Li, Y., Hu, J. L., & Liu, H. W. (2009). Non-performing loans and bank efficiencies: An application of the input distance function approach. *Journal of Statistics and Management Systems, 12*(3), 435-450

Lin, J. Y. (2016). One belt, one road will benefit China – and the world. *Off Guardian, 4/3/2016.* Retrieved from off-guardian.org

Maltritz, D., Buhn, A., & Eichler, S. (2012). Modelling country default risk as a latent variable: A multiple indicators multiple causes approach. *Applied Economics, 44*(36), 4479-4688

Manasse, P., Roubini, N., & Schimmelpfennig, A. (2003). Predicting sovereign debt crises. *IMF Working Paper, 03/221*

Marlene, N. (1989). What bush owes. *The Nation, 248*(12), 400

Mendoza, E. G., & Terrones, M. E. (2008). An anatomy of credit booms: Evidence from macro aggregates and micro data. *NBER Working Paper 14049*

Mergaerts, F., & Vennet, R. V. (2016). Business models and bank performance: A long-term perspective. *Journal of Financial Stability, 22*, 57-75

Mody, A., & Sandri, D. (2012). The eurozone crisis: How banks and sovereigns came to be joined at the hip. *Economic Policy, 27*(70), 199-230

Monteleone, T. A. (2013). A vulture's gamble: high-stakes interpretation of sovereign debt contracts in NML capital Ltd v Republic of Argentina. *Capital Markets Law Journal, 8*(2), 147-165

Moorad, C. (2010). *An introduction to bond markets. Fourth Ed*ition. Chichester: Wiley

Niepelt, D. (2014). Debt maturity without commitment. *Journal of Monetary Economics, 68*, 37-54

Ozkan, F. G., & Sutherland, A. (1995). Policy Measures to Avoid a Currency Crisis. *The Economic Journal, 105(429).* 510-519

Ostrom, C. W. (1978). Time series analysis. Sage University Papers Series on Quantitative Applications in the Social Science, 07-009. Thousand Oaks, CA: Sage.

Paesani, P., Strauch, R., & Kremer, M. (2006). Public debt and long-term interest rates: The case of Germany, Italy and the USA. *European Central Bank, Working paper NO. 656*

Parkin, M., & Bade, R. (2015). *Foundations of Economics, 7th Edition.*Boston: Pearson Addison-Wesley.

Perri, F., & Neumeyer, A. (2005). Business cycles in emerging economies: The role of interest rates. *Journal of Monetary Economics, 52*(2), 345-380

Pirtea, M. G., Nicolescu, A. C., & Mota, P. R. (2013). An empirical study on public debt's determinants: Evidence from Romania. *Transylvanian Review of Administrative Science, 38,* 144-157

PricewaterhouseCoopers. (2008). The economic crisis poses challenges to China's wisdom on economic growth. Retrieved from http://www.pwc.com

Rabinovitch, S. (2013). China averts local government defaults. *The Financial Times.* Retrieved from http://www.ft.com

Rajkumar, W. A. (2011). Money supply and inflation: A historical analysis. *IUP Journal of Monetary Economics, 9*(1), 22-45

Reinhart, C. M. (2010). This time is a different chartbook: Country history on debt, default, and financial crises. *NBER Wording Paper 15815*

Reinhart, C. M., & Rogoff, K. S. (2010). From financial crash to debt crisis. *NBER Working Paper,* No. 15795

Roberts, P. C., Kranzler, D., & Williams, J. (2014). The inflation-debt scam. *The International Economy, 28*(3), 42-44

Rodrik, D. (2007). The social cost of foreign exchange reserves. *International Economic Journal, 20*(3), 253-266

Rofman, R. (2012). The pension system and the crisis in Argentina: Learning the lessons. *The World Bank Working Paper*, 30489

Rowland, P., & Torres, J. L. (2004). Determinants of spread and creditworthiness for emerging market sovereign debt: A panel data study. *Banco de la Republica – Colombia*, Retrieved from http://www.banrep.gov.co/

Sarel, M. (1996). Nonlinear effects of inflation on economic growth. *International Monetary Fund Staff Papers, 43*(1), 199-215

Silk, R. (2013). China's foreign exchange reserves jump again. *The Wall Street Journal*. Retrieved from http://asia.wsj.com/

Spiegel Online. (2013). Crisis Control: Stability Fund Chief Expects Third Greek Bailout. Retrieved from http://www.spiegel.de/international/

Thakrar, S. (2013). The state and the banking sector in China. *Seven Pillars Institute, 10*(2013)

The coming debt burst: China's financial system. (2016). *The Economist, 416,* 7 May 2016: 10(US)

Thorbecke, W. (2011). Investigating the effect of exchange rate changes on China's processed exports. *Journal of the Japanese and International Economies, 25*(2), 33-46

Thornton, J., & Vasilakis, C. (2016). Does inflation targeting reduce sovereign risk? Further evidence. *Finance Research Letters, 18*, 237-241

Tielens, J., Van Aarle, B., & Van Hove, J. (2014). Effects of Eurobonds: A stochastic sovereign debt sustainability analysis for Portugal, Ireland and Greece. *Journal of Macroeconomics, 42*, 156-173

Wade, R. (1998). The Asian debt and development crisis of 1997-?: Causes and consequences. *World Development, 26*(8), 1535-1553

Weidemaier, W. M. C. (2013). Sovereign debt after NML v Argentina. *Capital Markets Law Journal, 8*(2), 123-131

Weiner, J. (2013). Assessing the affordability of state debt. *IDEAS Working Paper Series*

William, T. (2013). Don't ignore the Greek problem. *Barron's, 93*(33), 37

Work on Gojra-Shorkot motorway begins. (2016). Dawn News. April, 11, 2016.

Wu, H., & Feng, S. (2014). Astudy of China's local government debt with regional and provincial characteristics. *China Economic Journal, 7*, 277-298

Wu, J., Gyouko, J., & Deng, Y. H. (2012). Evaluation conditions in major Chinese housing markets. *Regional Science and Urban Economics, 42*(3), 531-543

Xu, J., Gan, C., & Hu, B. (2015). An empirical analysis of China's big four state-owned banks' performance: A data envelopment analysis. *Journal of Banking Regulation, 16*(1), 1-21

Xu, J., & Zhang, X. (2014). China's sovereign debt: A balance-sheet perspective. *China Economic Review, 31*(2014), 55-73

Yue, H. L. (2013). China's ambitious plans for its huge reserves. BBC business. Retrieved from http://www.bbc.co.uk

Yue, V. Z. (2010). Sovereign default and debt renegotiation. *Journal of International Economics, 80*, 176-187

Zhang, Y., & Han, K. (2013). When cracks appeared in the China interbank market.

The Wall Street Journal. Retrieved from http://www.marketwatch.com/

Zhang, M. (2013a). China's local government debt crisis: Through heavily leveraged and linked to shadow banks, provincial infrastructure spending will come just short of a hard landing. *International Business Times.* Retrieved from http://www.ibtimes.com/

Zhang, M. (2013b). China shadow banking, fed tapering: Credit crunch forced PBOC to give in; will the fed hold firm? *International Business Times.* Retrieved from http://www.ibtimes.com/

Appendix A

Table A Regression Results of the Debt Dynamics Model

Dependent Variable: LOG(SD)				
Method: Least Squares				
Date: 07/09/15 Time: 15:22				
Sample (adjusted): 2 19				
Included observations: 18 after adjustments				
White heteroskedasticity-consistent standard errors & covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	10.09313	4.713261	2.141433	0.0646
LOG(DD(-1))	-0.453572	0.153400	-2.956799	0.0182
LOG(FD(-1))	0.435566	0.654137	0.665863	0.5242
LOG(E)	5.252541	1.115607	4.708235	0.0015
LOG(R)	0.626758	1.826926	0.343067	0.7404
EG	1.637737	0.687451	2.382334	0.0444
DIR	-11.15154	4.708040	-2.368617	0.0453
FIR	-0.118659	0.387175	-0.306475	0.7671
LOG(IF)	-1.665307	2.261009	-0.736532	0.4824
EXL	-2.48E-05	1.70E-05	-1.460663	0.1822
R-squared	0.745897	Mean dependent var		0.163218
Adjusted R-squared	0.460031	S.D. dependent var		0.217651
S.E. of regression	0.159936	Akaike info criterion		-0.527909
Sum squared resid	0.204635	Schwarz criterion		-0.033258
Log likelihood	14.75118	Hannan-Quinn criter.		-0.459704
F-statistic	2.609254	Durbin-Watson stat		2.113637
Prob(F-statistic)	0.095766			

Appendix B

Table B Regression Results of the Sovereign Risk Model

Dependent Variable: SR				
Method: ML - Ordered Logit (Quadratic hill climbing)				
Date: 07/22/15 Time: 13:27				
Sample: 1 19				
Included observations: 19				
Number of ordered indicator values: 3				
Convergence achieved after 53 iterations				
Coefficient covariance computed using the Huber-White method				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
DA	1.173650	0.429649	2.731650	0.0063
DB	22.79635	6.260235	3.641453	0.0003
DR	98.03222	4.759725	20.59619	0.0000
EG	-4.47E-05	1.39E-05	-3.225913	0.0013
IF	-15.87999	0.698289	-22.74127	0.0000
Limit Points				
LIMIT_3:C(6)	787.5036	57.28111	13.74805	0.0000
LIMIT_4:C(7)	936.6469	50.59509	18.51260	0.0000
Pseudo R-squared	1.000000	Akaike info criterion		0.736842
Schwarz criterion	1.084793	Log likelihood		-2.00E-15
Hannan-Quinn criter.	0.795729	Restr. log likelihood		-20.07494
LR statistic	40.14988	Avg. log likelihood		-1.05E-16
Prob(LR statistic)	0.000000			

Appendix C

Table C Regression Results of the Bank Risk Model

Dependent Variable: Z				
Method: Panel EGLS (Period random effects)				
Date: 10/12/15 Time: 12:53				
Sample: 2006 2014				
Periods included: 9				
Cross-sections included: 8				
Total panel (unbalanced) observations: 69				
Swamy and Arora estimator of component variances				
Cross-section SUR (PCSE) standard errors & covariance (d.f. corrected)				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-58.56402	35.04145	-1.671278	0.0999
EG	121.3874	65.22013	1.861195	0.0676
SR	5.752173	2.017570	2.851039	0.0060
IF	-1.083824	0.635968	-1.704212	0.0935
GDY	5.161521	2.474211	2.086128	0.0412
PS	0.185673	0.674025	0.275469	0.7839
DL	-1.753590	0.549193	-3.193030	0.0022
CAR	0.389506	0.966329	0.403078	0.6883
DUMMY	2.525158	1.286899	1.962204	0.0544
Effects Specification				
			S.D.	Rho
Period random			0.000000	0.0000
Idiosyncratic random			4.407852	1.0000
Weighted Statistics				
R-squared	0.250518	Mean dependent var		12.19644
Adjusted R-squared	0.150588	S.D. dependent var		4.644373
S.E. of regression	4.280420	Sum squared resid		1099.320
F-statistic	2.506917	Durbin-Watson stat		0.304550
Prob(F-statistic)	0.020235			
Unweighted Statistics				
R-squared	0.250518	Mean dependent var		12.19644
Sum squared resid	1099.320	Durbin-Watson stat		0.304550

Appendix D

Using Yield Spreads as Sovereign Debt Risk Indicator in China

Sovereign debt risk in a country cannot be observed directly; thus, estimators are needed to measure sovereign debt risk. Generally, there are two main indicators that are widely used to estimate sovereign debt risk in the literature: yield spreads and sovereign ratings (Maltritz et al., 2012 and Balima et al., 2017). Yield spreads are the yield difference from the secondary market between the sovereign bond yield in the target country and the yield of US bonds. Researchers, such as Arora and Cerisola (2001) and Rowland and Torres (2004), have used yield spreads to measure sovereign debt risk in their study. Sovereign ratings are long-term government debt ratings normally provided by three major agencies including S&P. Cantor and Packer (1996), Afonso (2002), Rowland and Torres (2004) and Chen, Chen, Chang and Yang (2013) employed S&P sovereign ratings as an indicator of sovereign debt risk.

In the current study, we investigated sovereign debt risk in China; yield spreads and government bond yields are not suitable in studying our data set. The reasons,which include both the shortages of the indicator itself and unique sovereign debt condition in China referring to the differences in government bond market between China and other countries, are show as follow:

1. Yield spreads capture the comparative sovereign debt risk of the target country based on the debt risk of the U.S./Germany government; both changes in Chinese sovereign debt risk and the U.S./Germany sovereign debt risk will impact the yield spreads. Therefore, using yield spreads to estimate sovereign debt risk has an assumption that the sovereign debt risk of the U.S./Germany government is constant, which is not the real case.
2. Yield spreads data is collected from the secondary market, which includes both investors and speculators; moreover, the investors are general not rational in buying and selling. Thus, the yield spreads may not able to capture the true sovereign risk for a selected country.
3. The most importantly, differ from many other countries; more than 65% of the Chinese sovereign debt is purchased by Chinese commercial banks especially state-owned commercial banks (data from AsiaBondsOnline, 2016). As a result, the strong political interference of Chinese government on state-owned commercial banks can significantly influence (decrease) the sovereign debt yield in China.

In addition, using yield spreads and government bond yield as the sovereign debt risk indicator in the sovereign risk model showed poor results as follow:

Table D Results of using government bond yield as sovereign debt risk indicator

Variables	Coefficient
Constant	0.584965
Debt/revenue ratio	0.001462
Debt/GDP ratio	-0.024326
Economic growth	-0.155982**
Inflation	0.052788

Table E Results of using yield spreads as sovereign debt risk indicator

Variables	Coefficient
Constant	1.933444
Debt/revenue ratio	0.030736
Debt/GDP ratio	0.071870*
Economic growth	-0.411585***
Inflation	-0.013489**

Note: t-statistics in parentheses below the estimates. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. F-statistic presents the joint significance of the coefficients of the explanatory variables.
Source: Author's calculations.

Both yield spreads results and government bond yield results showed similar results of the sovereign risk model in the current study which uses S&P sovereign ratings as sovereign debt risk indicator in China. However, using government debt yield and yield spreads as sovereign debt risk indicator showed insignificant impact of many macroeconomic fundamentals. These suggest that bond yield and yield spreads may be inadequate in measuring sovereign debt risk in China.

Appendix E

Results of Bank Risk Model with a Selection of 17 Commercial Banks

As discussed in Section 3.2, there are two types of commercial banks operate nationally in China: 5 state-owned commercial banks (Bank of China, China Construction Bank, Industrial and Commercial Bank of China, Agriculture Bank of China and Bank of Communications) and 12 non-state-owned joint-equity commercial banks (China CITIC Bank, China Everbright Bank, China Merchants Bank, Industrial Bank Co., Ltd, Hua Xia Bank Co., Ltd, China Guangfa Bank, Ping An Bank Co., Ltd, Shanghai Pudong Development Bank, China Minsheng Banking Crop., Ltd, Hengfeng Bank Co., Ltd, China Zheshang Bank Co., Ltd and China Bohai Bank Co., Ltd).

Selecting all the 17 commercial banks and using market share and bank ownership variables to control the size and type of each bank is an alternative method to eliminate the bias impact of bank size and type on bank risk in China. Results are presented in the follow table:

Table F Results of Bank Risk Model (17 Commercial Banks)

Variable	Coefficient Estimates
Sovereign risk	2.177**
	(2.181)
Economic growth	37.106***
	(2.695)
Inflation	-0.377**
	(-2.068)
Debt interest rate	1.679***
	(3.299)
Profit per share	1.445
	(0.554)
Non-performing loan rate	-0.087**
	(-2.008)
Capital adequacy ratio	-0.362
	(-0.607)
Bank ownership	3.675
	(1.042)
Market share	0.068
	(0.160)
Year	-0.276
	(-0.955)
Number of observations	150
LR statistic	31.69
Prob (LR statistic)	0.000***

Notes: t-statistics in parentheses below the estimates. *, **, and *** indicate 10%, 5%, and 1% significance levels, respectively. LR-statistic presents the joint significance of the sovereign risk model.
Source: Author's calculations.

Table F showed similar coefficients of the bank risk model results in Table 4.5.

However, bank ownership and market share showed insignificant impact on bank risk in China, which suggests that the bank size and type do not have a significant impact on bank risk; this is not the reality. Adding a new variable – market share to control the bank size may lead both market share and bank ownership insignificant in the model because state-owned commercial banks are large-sized commercial banks and non-state-owned commercial banks are middle- and small- sized commercial banks in China: 5 state-owned commercial banks of China occupies approximately 75% of the market share in China during our study period (2006-2014). Thus, a potential multicollinearity problem between bank size and bank type may contribute to the insignificant impact of bank ownership and market share variables in the model. Exclude market share from the bank risk model will solve the problem and make the bank ownership significant in the model; however, it can also create bias from bank size in the bank risk model.